Food and Agriculture Organization of the United Nations

CPF Collaborative Partnership on Forests

Global assessment of forest education

Creation of a Global Forest Education Platform and Launch of a Joint Initiative under the Aegis of the Collaborative Partnership on Forests (FAO-ITTO-IUFRO project GCP /GLO/044/GER)

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Global assessment of forest education

Creation of a Global Forest Education Platform and Launch of a Joint Initiative under the Aegis of the Collaborative Partnership on Forests (FAO-ITTO-IUFRO project GCP /GLO/044/GER)

by
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Cover photograph: Sand Creek, Rupununi, Guyana - Sand Creek Secondary School Students from the newly formed Wildlife Club attend a lecture and a short excursion outside where they learn more about their immediate environment

Contents

Foreword *vii*
Acknowledgements *ix*
Acronyms and abbreviations *xi*
Executive summary *xii*

1. Background **1**

1.1. The need to strengthen forest education 1
1.2. The global initiative on forest education 2
1.3. Frame of reference 4

2. Introduction to the forest education assessment **7**
2.1 Objective and description of the ASSESSMENT 7
2.2 Forest education in six regions 8
Africa (AF) 8
Asia and the Pacific (AP) 9
Europe 11
Latin America and the Caribbean (LAC) 12
North America (NA) 13
Near East and North Africa (NENA) 15

3. Survey methods and responses **17**
3.1. Survey methodology 17
3.2 Respondents 18

4. Survey results **23**
4.1. Primary education 23
4.1.1 Education content and competencies in primary education 23
4.1.2 Teaching approaches in primary education 24
4.1.3. Educational resources and policy in primary education 25
4.2. Secondary education 27
4.2.1. Education content and competencies in secondary education 27
4.2.2. Teaching approaches in secondary education 29
4.2.3. Educational resources and policies in secondary education 30
4.2.4. Readiness for forest education after secondary education 32
4.3. Technical and vocational education and training 33
4.3.1. Education content and competences in technical and vocational education and training 33

4.3.2. Educational resources and policy in technical and vocational education and training 34
4.3.3. Workplace readiness and employability in technical and vocational education and training 35
4.3.4. Digital readiness in technical and vocational education and training 36
4.3.5. General developments and trends in technical and vocational education and training 36
4.4. University and college education 37
4.4.1. Bachelor's level 37
4.4.2. The master's and PhD level 44
4.4.3. All university and college levels 49

5. Discussion and conclusions 51
5.1 Regional consultations 52
5.2. Primary and secondary education level 53
5.3. The technical and vocational education and training level 54
5.4. University and college level 55

6. Recommendations 59

7. References 63

Tables

1. Respondents by target group (statistical sampling bolded) and regions and countries (snowball sampling) 18
2. Numbers of survey respondents for each level of education 19
3. Sociodemographic characteristics of the respondent groups: professionals, teachers and students 20
4. Students' current or planned place of studies 21
5. Workplace background of the professionals 22
6. Actions that would have the greatest impact on improving primary students' knowledge and appreciation of forests and forest-related topics 25
7. Coverage of forest-related themes, topics and skills in bachelors' programmes 37
8. Workplace readiness and employability at the bachelor's level 43
9. Workplace readiness and employability at the master's and PhD level 48

Figures

1. Milestones of the Global Forest Education Project 4
2. Frame of reference for the assessment of forest education 4
3. Six regions in the global forest education survey 8
4. Topics and skills covered in primary education 23
5. Recommended teaching approaches to improve learning and increase students' interest in forest-related concepts at the primary level 25
6. Availability of forest education resources in primary schools 26
7. Perceptions on the availability of policies or strategies for improving forest education at the primary level 27
8. Level of forest-related topics included in the secondary school curriculum and level of interest in incorporating forest-related topics into the school curriculum 28
9. Topics and skills covered in secondary education 29
10. Recommended improvements to learning and increased student interest in forest-related concepts in secondary education 30
11. Availability of forest education resources in secondary schools 31
12. Perceptions concerning the existence of policies or strategies leading to improved forest-related curricula in secondary schools 32
13. Student motivation for entering higher-level forest courses or programmes following secondary education 33
14. Topics and skills covered in technical and vocational education and training 34
15. The availability of policies or strategies for improvement of forest-related education at the technical and vocational education and training level 35
16. Coverage of forest-related topics in bachelor's programmes 39
17. Availability of resources in forest degree programmes at the bachelor's level 40
18. Policies or strategies leading to improved forest-related education in bachelor's programmes 41
19. Availability of part-time employment or forest-related internships at the bachelor's level 42
20. Coverage of forest-related topics in master's and PhD programmes 44
21. Availability of resources in forest degree programmes at the master's and PhD level 45
22. Policies or strategies leading to improved forest-related education at the master's and PhD level 46
23. Availability of part-time employment or forest-related internships at the master's and PhD level 47

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Foreword

Over the past two decades, in many parts of the world, concerns have been repeatedly raised that forest-related education is lacking and under-resourced. In addition, it may also vary according to regions: it may excessively focus on one issue or be too general. Stakeholders have noted that graduates from forest education and training programmes are too often insufficiently prepared to meet the needs of the evolving forest sector workplace. Unfortunately, a concerted global response has yet to emerge to address these and other gaps.

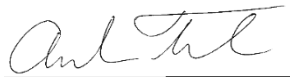
Knowledgeable and well-trained forest sector workers, entrepreneurs, practitioners, researchers, professionals and policy makers are essential for the future of forests. High quality and widely available forest education that also includes indigenous and traditional forest-related knowledge is an essential foundation for enabling forests and trees to contribute to climate action, ecological restoration, biodiversity conservation, sustainable economic development, green cities and human health. While international fora and studies have noted promising developments in forest education, it has long been clear that action is needed in this area for forests to be able to fulfil local, national and global needs.

In 2019, recognizing this pervasive challenge, the Food and Agriculture Organization of the United Nations (FAO), the International Union of Forest Research Organizations (IUFRO) and the International Tropical Timber Organization (ITTO) initiated the Global Forest Education Project. It engaged thousands of forest education stakeholders around the world to collect, synthesize and verify the status of forest education. This report is the culmination of this project's data collection and analytical work. It captures the results of a global survey, expert consultations and literature review.

This report, Global Assessment of Forest Education, examines the status of forest education and identifies much needed actions to meet global needs. Its purpose is to inform individual and multi-actor efforts, including those of the Collaborative Partnership on Forests, to strengthen forest education, training and knowledge-sharing systems. It provides information to support the achievement of various Sustainable Development Goals (SDGs) and global forest-related goals, including for the United Nations Educational, Scientific and Cultural Organization- (UNESCO) led framework for Education for Sustainable Development for 2030.

We partners in this endeavour were delighted to have our organizations support the project that produced this report. We thank the authors for their excellent work in synthesizing findings at regional and global levels, and drawing conclusions to inform action. We thank even more the thousands of forest education stakeholders who contributed their knowledge, experiences and perspectives to this project in myriad ways.

Our hope is that this report will inform future action to strengthen forest education that thank benefit forests and trees and contribute to the wellbeing of global society and the planet. Ultimately, we hope that it will inform a Renaissance in forest education that the world so clearly needs.



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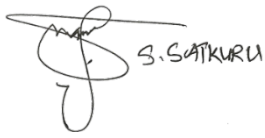

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This report is based on the results of the 2020 Global Forest Education Survey, supplemented by findings of six regional assessment reports on forest education, carried out under the project, "Creation of a Global Forest Education Platform and Launch of a Joint Initiative under the Aegis of the Collaborative Partnership on Forests" (informally referred to as the "Global Forest Education Project"). The project was led by the Food and Agriculture Organization of the United Nations (FAO), the International Tropical Timber Organization (ITTO) and the International Union of Forest Research Organizations (IUFRO). The major partners that contributed to regional aspects of the project were as follows: from Africa, the African Network for Agriculture, and Agroforestry and Natural Resources Education (ANAFE); from Asia and the Pacific, RECOFTC and ITTO; from Europe, the University of Helsinki, Forum4Edu and IUFRO; from Latin America and the Caribbean, IUFRO; from Near East and North Africa, the Arab Organization for Agricultural Development (AOAD); and from North America, the University of British Columbia (UBC), Michigan Technological University (MTU), the Project Learning Tree (PLT) and the Sustainable Forestry Initiative (SFI).

The project was funded by the Government of Germany's Federal Ministry of Food and Agriculture (BMEL), which deserves special gratitude.

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This Global Assessment of Forest Education report relies heavily on six regional assessment reports. The regional reports were based on data collected by the Global Forest Education Survey supplemented by published literature and findings of regional consultations on forest education organized by the project. The authors of this report gratefully acknowledge all authors of the regional assessment reports.

The authors of the Regional Assessment formed a project team together with FAO employees mentioned above. The authors of the Regional Assessment of Forest Education in Africa were James B. Kung'u, Bethsheba K. Muchiri and Anne Kuria. Muchiri and Anne Kuria. The authors of the Regional Assessment of Forest Education in Asia and the Pacific were Mike Shanahan, Sirichai Saengcharnchai, Julian Atkinson and

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The authors of this report would also like to thank the almost 500 experts who participated in the project's regional consultations, and all moderators and speakers who made International Conference on Forest Education in 2021 a great success. Finally, the authors wish to thank all 2 741 respondents – professionals, teachers and students – of the Global Forest Education Survey.

Acronyms and abbreviations

AF	Africa
AP	Asia and the Pacific
CEDEFOP	European Centre for the Development of Vocational Training
CPF	Collaborative Partnership on Forests
COVID-19	Coronavirus disease of 2019 (SARS-CoV2)
FAO	Food and Agriculture Organization of the United Nations
FRA	Global Forest Resources Assessment
GDP	Gross domestic product
ITTO	International Tropical Timber Organization
IUFRO	International Union of Forest Research Organizations
LAC	Latin America and the Caribbean
NA	North America
NENA	Near East and North Africa
NGO	non-governmental organization
PhD	Doctoral degree
PLT	Project Learning Tree
RLP	Regional Lead Partner
SDG	Sustainable Development Goal
TVET	technical and vocational education and training
UC	Universities and colleges
UNESCO	United Nations Educational, Scientific and Cultural Organization

Executive summary

The Global Forest Education Project[1] (2019-2021) was aimed at assessing the goals, achievements and gaps of forest education at all levels of formal education in order to catalyse and enhance efforts in forest education from local to global levels. The Food and Agriculture Organization (FAO) of the United Nations, the International Tropical Timber Organization (ITTO) and the International Union of Forest Research Organizations (IUFRO) were the lead partners of the project. The project was designed to prepare the foundation for long-term efforts in forest education and included a Joint Initiative of the Collaborative Partnership on Forests (CPF). Among other activities, the project conducted a global survey on forest education, literature reviews and expert consultations in six regions: Africa (AF), Asia-Pacific (AP), Europe, Latin America and the Caribbean (LAC), Near East and North Africa (NENA) and North America (NA). This global assessment report presents the key findings from all regions, draws common conclusions and provides recommendations at the global level.

The role of the forest in countries' efforts to achieve the United Nations Sustainable Development Goals (SDGs) are widely recognized. To maximize the contribution of forests to the SDGs, a workforce trained in forestry and a broad range of other forest-related disciplines are needed as are widespread public knowledge and understanding of forest topics. However, recent literature highlights concerns that forest education is often not meeting the fast-changing needs of the labour market and the importance of forests and of forest managers and policymakers is often under-appreciated.

The scope of this report covers education and training related to forests, trees outside forests and other wooded land (i.e. natural forests, forest plantations, woodlands, agroforests and urban forests). It includes education delivered through programmes of forestry and forest sciences as well as programmes of broader scope, (e.g. natural resources management, environmental sciences). It covers all levels of formal education: primary, secondary, technical and vocational education and training (TVET) and universities and colleges (UC).

Data were collected by the project's Global Forest Education Survey, which was carried out between July and October 2020. The survey responses were disaggregated by region, and the regional reports were prepared using these data supplemented by the published literature and findings of regional consultations on forest education convened in February 2021. The survey had three groups of respondents: professionals working in organizations, government agencies and the private sector; teachers and school administrators from all levels of formal education; and students and recent graduates of TVET and UC forest

[1] Formally entitled "Creation of a Global Forest Education Platform and Launch of a Joint Initiative under the Aegis of the Collaborative Partnership on Forests".

programmes. Despite difficulties created by the COVID-19 pandemic, overall, 2 741 people in six regions completed the survey questionnaire. The respondents provided data on a range of topics including educational content and competencies, teaching approaches, educational resources and policies, workplace readiness and employability, digital readiness and general development and trends in education. When considering a particular respondent group at a certain level of education in a specific region, the number of respondents was relatively limited. Despite this limitation, regional assessments identified some common key findings, as discussed below.

Curricula. Regional assessments revealed a widespread perception that there is insufficient coverage of forest-related topics, especially at the primary and secondary school levels, where youth are at a prime age to develop an affinity with forests and those who care for them. Topics considered to be especially lacking included cultural and social values, traditional knowledge and rights of forest communities, and the contributions of trees and forests to local people. Topics at the TVET and UC levels were considered better covered, although there were some exceptions, including forest services and cultural and social issues such as gender, race/ethnicity, and traditional and indigenous knowledge. Unexpectedly, generic skills such as communication, critical thinking and collaboration, were not considered particularly lacking by the survey respondents except by graduate (master's and PhD) students.

Although all topics were considered inadequately covered at the primary and secondary level globally, some topics fared better than others, including, at the primary level, plants and animals that live in and around forests and respect for forests and nature, and at the secondary level, forest biodiversity, deforestation and forest degradation, and respect for forests and nature. At all tertiary educational levels (including TVET and UC), forest resources and forest ecology were consistently deemed to have the best coverage. Thus, the picture that emerges is one of insufficient coverage of social and cultural values of forests at all educational levels, with better coverage of the biophysical dimensions of forests. It is interesting to note that, coverage of forest planning and management was rated between social and cultural values and biophysical dimensions of forests.

Teaching approaches and students' exposure to forests. Students at all levels were reported to have limited access to forests. At the primary and secondary levels, outdoor learning was ranked the highest among all recommended improvements to learning. At TVET and UC levels, students had limited opportunities for field experience, internships and practical training.

Diversity of students. In an increasingly interconnected and complex world, diverse and representative cadre of forest sector employees is needed. However, findings elsewhere in the literature that females and racial/ethnic minorities are more hesitant than their male and racial/ethnic majority counterparts to enrol in forest education schools at the tertiary level were reinforced by the findings of the assessment. Employability challenges facing women in some regions were reported in this study, with a number of women respondents stating that a forest graduate's gender is *moderately* or *very much* a factor in his/her ability to find a job and, more so, in the types of jobs offered him/her.

Digital readiness. Respondents were generally positive about the value of digital learning tools but reported that their use was less than ideal. At the primary and secondary levels, teachers indicated a lack of capacity in their digital skills. At the TVET and UC levels it was frequently perceived that digital tools cannot replace field education. Limitations in some regions were due to internet accessibility, inadequate equipment and unskilled teachers.

Workplace readiness. The assessment revealed that globally, TVET and university and college graduates are on average *moderately* prepared to enter the workforce. These average results should be better. Need for improvement is especially evident in the regions where results of workplace readiness were closer to the level *to a limited extent* than moderate. Reasons for non-optimal results are presumably some gaps in curricula, insufficient opportunities for practical training including in forests, insufficient digital readiness and some limitations in educational resources.

Governance and policy. Forest education, especially at the primary and secondary level, faces gaps in resources, support and governance. More coordinated efforts would enhance teachers' use of forest-related educational materials and pedagogical approaches, and stakeholders' provisions for supporting forest education in order to engage students with forests.

Mixed general developments and trends. Enrolment trends vary; i.e. some programmes are declining in number of new students whereas enrolment is increasing elsewhere. The reasons for this are not clear. In general, environmental awareness in societies is on the rise, not the least because of topics such as climate change and COVID-19. However, forest education is not fully capable of responding to these drivers. Negative images are often attached to jobs in rural areas and forestry. Efforts to improve forest education should therefore go hand in hand with wider efforts to informally educate society on the crucial importance of forests and forest professionals, and the opportunities that forests provide for meeting sustainability goals.

In conclusion, there is a need for locally relevant, appropriate and inclusive solutions that take into account digital divides, language barriers and a gender and racial/ethnic balance in forest education programmes and the workforce. Forest education is a tiny sector among educational branches; however, it has the potential to play a much larger role. With a better understanding and alignment among forest-related stakeholders, it can make a difference in attaining the Sustainable Development Goals (SDGs) in several spheres of society.

1. Background

1.1. THE NEED TO STRENGTHEN FOREST EDUCATION

Forest education is the primary means of building the knowledge, skills and shared values that underpin sustainable forest management (SFM) and contributions of SFM to the achievement of environmental, social and economic development goals from local to global levels.

Over the past several years, however, various international fora have expressed a concern that, in many places, forest-related education is insufficient, deteriorating or outdated, which results in insufficient awareness and understanding of forests and to forest graduates who are inadequately prepared to meet the changing demands of the workplace.

Various reports indicate that countries around the world have experienced variations in student enrolment in forest education programmes and have faced challenges in including forest-relevant topics within curricula (van Lierop, 2003; Temu and Kiwia, 2008; Rekola *et al.*, 2017; Jegatheswaran *et al.*, 2018; Sharik *et al.*, 2019 and 2020).

Global Forest Resources Assessment (FRA) 2020 of the Food and Agriculture Organization of the United Nations (FAO) (FAO, 2020) includes information on forest enrolment trends in post-secondary levels of education between 2000 and 2015 gathered across 119 countries and territories. In these countries that provided information across all education levels and complete time-series data (representing approximately half of the global forest area), there has been a general increase in the number of forestry graduates and a marked advancement towards gender parity. However, FRA 2020 warns that these optimistic trends should be treated with caution since the data are incomplete.

Forest education has been largely missing from the global forest policy agenda for nearly 20 years, including due to FAO's reduced efforts on this topic. Recently, however, there has been a rekindled interest in forest education, as reflected in increased activities of various research organizations and non-governmental organizations (NGOs), and, notably, the inclusion of forest education on the agenda of the 14th session of the United Nations Forum on Forests held in May 2019. This signals a growing realization that forest education can and must be part of the solution to many pressing needs, such as reducing the rate of deforestation and forest degradation, protecting ecosystems, enhancing livelihoods and safeguarding human health and well-being, conserving biodiversity, and mitigating and adapting to climate change.

There is greater awareness that forest education must adapt to the many challenges facing the forest sector. These challenges include:

- changes in societal expectations related to the goods and services that forests provide to communities, and in how forests are perceived;
- changes in employment trends, and thus the need for further training and education within the forest sector to maintain a strong cadre of skilled foresters and environmental professionals;
- a lack of interest in the forest sector, which needs to be revamped and rebranded to attract the most talented and interested students to study and manage the world's forests and inter-dependent ecosystems;
- an ageing workforce in many countries;
- a curriculum that is often outdated, too narrowly focused, and in need of broadening to integrate key emerging topics.

There is an urgent need to rekindle interest in forest education, strengthen and expand the programmes, and tap into emerging opportunities, including those offered by modern digital information and communication technologies, and new types of jobs in the growing the green economy. This needs to be accompanied by greater appreciation and use in education systems of indigenous and traditional forest-related knowledge for managing and protecting these natural resources.

Target 7 of the Sustainable Development Goal (SDG) 4, Quality education, specifically underlines the need for improved education on sustainable development:

> *By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development.*

Without a resurgence in forest education, it will be difficult to achieve sustainable forest management, secure widespread recognition of the full value of forest goods and services, and overcome the growing disconnect between people, nature and forests. Without robust and suitable forest education, it is unlikely that forests and trees will fulfil their potential contributions to the achievement of global development goals and targets, including the SDGs, the targets of the United Nations Framework Convention on Climate Change (UNFCCC), the post-2020 Global Biodiversity Framework of the United Nations Convention on Biological Diversity (CBD), the United Nations Strategic Plan for Forests, and other global goals.

1.2. THE GLOBAL INITIATIVE ON FOREST EDUCATION

The Global Forest Education Project, formally entitled, "Creation of a Global Forest Education Platform and Launch of a Joint Initiative under the Aegis of the Collaborative Partnership on Forests", was carried out between November 2019 and September 2021. It was generously funded by Germany's Federal Ministry for Food and Agriculture (BMEL).

The project was implemented by three lead project partners: FAO, the International Tropical Timber Organization (ITTO) and the International Union of Forest Research Organizations (IUFRO), with the collaboration in some project activities of other members of the Collaborative Partnership on Forests (CPF) and of regional lead partners (RLPs) who carried out regional-level project activities. The partners involved in regional activities were:

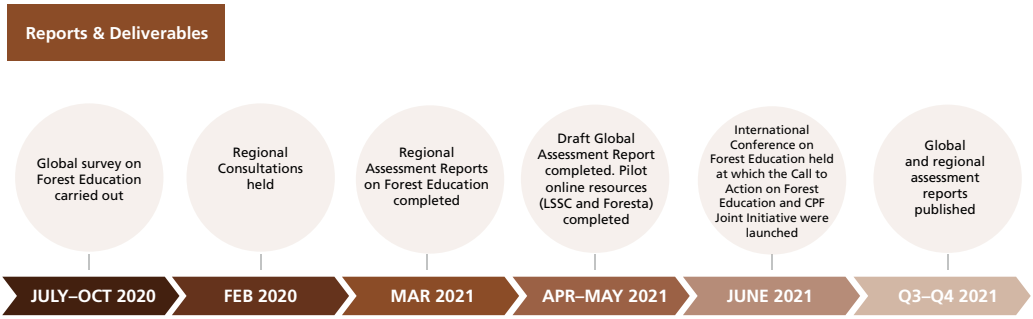
- Africa: African Network for Agriculture, Agroforestry and Natural Resources Education (ANAFE)
- Asia and the Pacific: RECOFTC and ITTO
- Europe and Central Asia: University of Helsinki, Forum4Edu and IUFRO
- Latin America and the Caribbean: IUFRO
- Near East and North Africa: Arab Organization for Agricultural Development (AOAD)
- North America: University of British Columbia (UBC), Michigan Technological University (MTU) and Project Learning Tree (PLT)/Sustainable Forestry Initiative (SFI).

For the purpose of the project, forest education was defined as education related to forests, other wooded land, and trees outside forests, including natural forests, forest plantations, woodlands, agrarian forests and urban forests. The project focus was on formal education at primary, secondary, technical and vocational, and university and college (UC) levels.

The project consisted of several interrelated activities aimed at taking stock of the current status of forest education (see Figure 1). It carried out the Global Survey on Forest Education between July and October 2020. The survey results, supplemented with information from other sources, informed the first drafts of six regional assessment reports. Each regional report assessed the status of forest education in the region and provided a set of recommendations to strengthen it. The reports served as background material for regional consultations on forest education, which were convened in February 2021. The final regional reports, including findings of the regional consultations, were used to prepare this Global Assessment on Forest Education. In June 2021, an International Conference on Forest Education was held in which the findings of the global assessment and recommendations for action to strengthen forest education globally were discussed.

The project carried out two pilot activities to develop online resources aimed at enhancing forest education. Under the leadership of IUFRO, the prototype of forestra®, an enhanced online platform for consolidating and making accessible forest education resources globally, was developed. As a pilot effort to explore new approaches and technologies for training and education, ITTO developed an online course on Legal and Sustainable Supply Chains for Tropical Wood and Tropical Wood Products (LSSC).

Figure 1. Milestones of the Global Forest Education Project

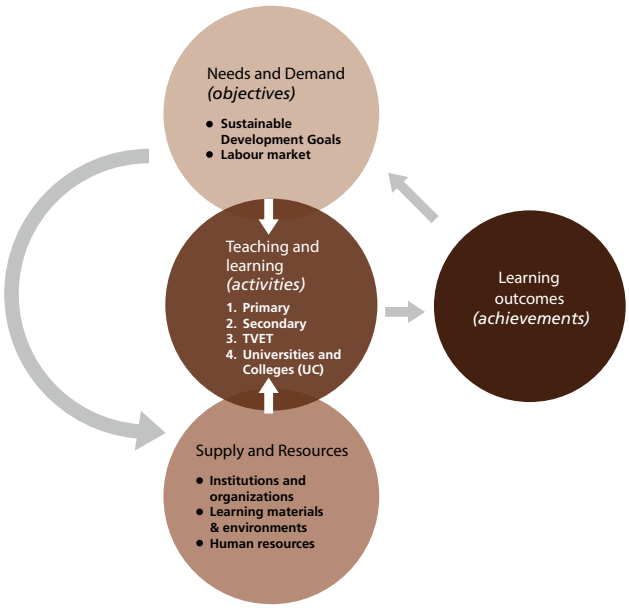

Reports & Deliverables
Global survey on Forest Education carried out
Regional Consultations held
Regional Assessment Reports on Forest Education completed
Draft Global Assessment Report completed. Pilot online resources (LSSC and Foresta) completed
International Conference on Forest Education held at which the Call to Action on Forest Education and CPF Joint Initiative were launched
Global and regional assessment reports published
JULY–OCT 2020
FEB 2020
MAR 2021
APR–MAY 2021
JUNE 2021
Q3–Q4 2021

The culmination of the project was the launch of a multi-year, multi-partner initiative of the Collaborative Partnership on Forests (CPF). The CPF Joint Initiative will address contemporary and emerging challenges facing forest education. Its scope encompasses formal forest education, informal and continuing forest education, and indigenous and traditional forest-related knowledge.

1.3. FRAME OF REFERENCE

A frame of reference was adopted as the conceptual framework for the global forest assessment on forest education. It was also instrumental in defining the questions posed in the Global Survey on Forest Education. The frame of reference consists of four main components of forest education and their relationships (Figure 2).

Figure 2. Frame of reference for the assessment of forest education



'Needs and demand' describe the objectives for education. 'Needs' are defined as general socially desirable objectives, in particular the SDGs. 'Demand' refers to more narrowly defined (economic) requirements on how much and which kinds of skills and competencies are required in the labour market.

'Supply and resources' are inputs needed to organize and implement educational programmes. There are direct and indirect links between 'needs and demand' and 'supply and resources'.

'Teaching and learning' are the essential and central components of education. They are mutually interacting activities, like two sides of the same coin. In this regard, in formal education, talking about learning without teaching is not meaningful. Learning takes place constantly, but in organized, structured learning environments, teaching is key to successful 'learning outcomes' or intended learning outcomes (see, for example, Biggs and Tang, 2011).

'Learning outcomes' (or achievements) are the competencies of students upon graduation, including their knowledge and skills, but also their attitudes and values. Competences can be subject-specific – i.e. related to forest-based knowledge and skills including ecological, technological and socio-economical aspects of forests and forestry, and generic skills such as literacy and numeracy, communication, teamwork and leadership.

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2. Introduction to the forest education assessment

2.1 OBJECTIVE AND DESCRIPTION OF THE ASSESSMENT

This Global Assessment of Forest Education is based on six regional assessments covering the globe (Figure 3). The global and regional assessment reports appraise the current status of formal forest education at all educational levels; identify gaps and areas that need strengthening; provide information on key initiatives evaluating or enhancing forest education as well as actors engaged to this end; and present recommendations of actions that could be taken to strengthen forest education globally and in each region.

The levels of education analysed were:

- primary education (in most countries from age 5 or 6 to age 12 or 13);
- secondary education (in most countries from age 12 or 13 to age 17 or 18);
- TVET;
- universities and colleges (UC).

This Assessment report covers education content and competencies, teaching approaches, educational resources and policy, workplace readiness and employability, digital readiness, and general developments and trends in forest education. These topics reflect the frame of reference that represents the conceptual framework for the assessment.

The aim of this assessment was to consolidate and synthesize the data and information from the regional assessment reports to yield a global picture of the status of forest education, highlight regional specificities and identify common needs and solutions across regions. The draft global assessment was used as a background document for the International Conference on Forest Education. The regional assessment reports provide far more detail than can be presented in this global assessment. Readers are encouraged to refer to these excellent regional reports for a more in-depth understanding of the situation in the various regions. The reports are available on the project website (www.fao.org/forestry/forest-education/en).

The regional assessments drew upon the following sources of information: the global survey on forest education carried out from July to October 2020, a review of scientific and grey literature, and regional consultations on forest education held virtually in January and February 2021.

A total of around 500 experts and stakeholders participated in the six regional consultations, giving invaluable insight and participating in fruitful discussions. The objectives of each consultation were to validate the findings of the draft regional assessment report and to finetune the recommendations to strengthen forest-related education in the region. The reports of all six regional consultations are available on the project website (www.fao.org/forestry/forest-education/en).

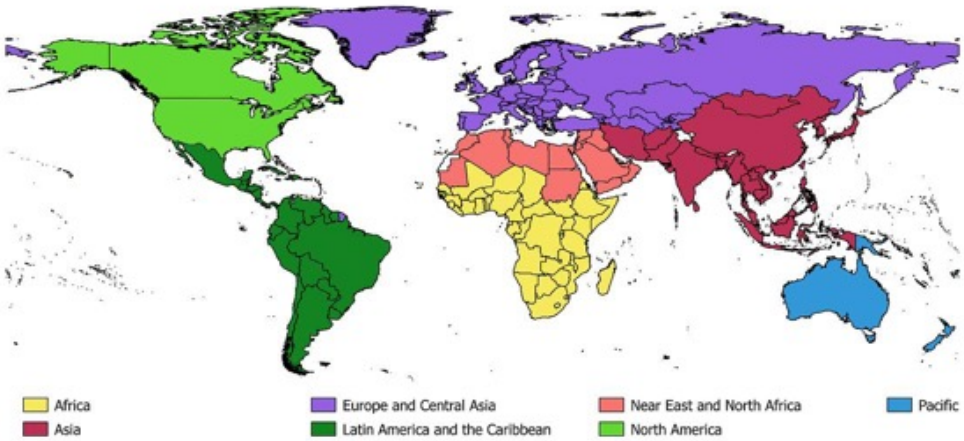
The consultations had the following intended learning outcomes for the participants:

- to gain a deeper understanding of the survey's contents and proposed recommendations;
- to identify and compare differences in forest education-related perceptions among participating countries;
- to propose potential improvements and identify stakeholders that could help implement them.

2.2 FOREST EDUCATION IN SIX REGIONS

Formal education related to forests is provided in various ways, depending on the ecological, social, political and economic conditions in a country. The following summaries of forests and educational systems in each of the six regions are based on the regional assessment reports.

Figure 3. Six regions in the global forest education survey



Source: FAO. 2017. Commission on Genetic Resources for Food and Agriculture - Item 2.1 of the Provisional Agenda. Sixteenth Regular Session Rome, 30 January – 3 February 2017. In: The State of the World's Biodiversity for Food and Agriculture (Draft). www.fao.org/3/MR762E/mr762e.pdf.

Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties. Final boundary between the Sudan and South Sudan has not yet been determined. Final status of the Abyei area is not yet determined.

Africa (AF)

Africa's forests and woodlands are estimated to cover approximately 650 million ha, including 15 million ha of plantations, or 21.8 percent of the continent's land area (FAO, 2020). In addition, there are an estimated 350 million ha (13 percent of the land mass) of 'other wooded land', such as single trees planted on farm boundaries, scattered trees in farmlands and woodlots. However, the capacity of forests to provide ecosystem services sustainably has

been continuously threatened by forest degradation and deforestation. African economies are often rooted in abundant natural resources drawn from a wide variety of ecosystems. Forests are an integral part of this fabric and can claim to be pillars of many African economies. In Africa, over two-thirds of the human population rely on forests for their livelihoods, and fuelwood accounts for about 70 percent of primary energy for households (Ebrahim and Weng, 2016).

Currently, in Africa, the primary education curriculum does not adequately cover the topics and skills on nature and natural resources. The availability of forest education resources and learning materials are absent or available to only a limited extent in many primary schools. These resources and materials are: textbooks and online materials; quality human resources such as teachers; environmental education resources such as laboratory access; adequate class size; and practical opportunities such as experiential learning and practical training. Moreover, lack of awareness raising among primary school students on nature or environmental studies has contributed to low interest in forest education.

Lack of government and education policies for forest education in secondary schools in Africa has contributed to its lower quality and prominence. Also, students in secondary schools receive little or no exposure to forests through out-of-school activities (e.g. clubs), which can increase their knowledge and appreciation of forests. Therefore, students are reported to lack enthusiasm for pursuing further studies in forestry either at technical and vocational training schools, or at a forest programme at the university and college level.

In many forest-rich African countries, forest education still follows the traditional colonial model introduced to the continent, mainly from Europe, i.e. the master-novice approach, and formal education is no older than 40–50 years (Temu, Okali and Bishaw, 2006). African forest education is based on traditional European education where industrial wood production and processing was the dominant theme, although today it is inevitably in transition as in many other parts of the world. Forest programmes are now highly variable, and today also include elements of agriculture, environmental and community forestry, and natural resources management. The private sector has increased access to mainly small, low-quality institutions including some TVET centres.

According to Cloete Maassen and Pillay (2015), higher education in Africa is a system that mainly serves the elite. Sub-Saharan Africa has a much lower participation rate than that of the rest of the world, averaging from 5 to 10 percent (*ibid.*). The challenges faced by forest education are many and include corruption and little interest in forest academic programmes. Other sectors with higher salaries, such as business, finance, engineering, and information and communication technology (ICT), offer more attractive career opportunities than the forest sector (Leslie, Wilson and Starr, 2006).

Asia and the Pacific (AP)

The forests of Asia and the Pacific (AP) region vary greatly in type, status and use. In much of the region, large areas of forest have been heavily logged and/or converted to agriculture and other land uses. About 64 percent of the region's forests are now secondary, with varying levels of degradation (FAO, 2019). The total forest area in the AP region

increased from 2010 to 2020, but much of this increase was due to afforestation with commercial plantations in China and other countries (FAO, 2020). The focus of forest management has generally shifted over time from timber production to sustainable forest management and biodiversity conservation, and more recently, to exploring multiple uses of forests (Jegatheswaran *et al.*, 2018; FAO, 2010). Increasingly, countries in the region are turning to community or social forestry (RECOFTC, 2020).

In 2015, the forestry sector employed more than 1.4 million people in Indonesia, the Lao People's Democratic Republic, Malaysia, the Philippines, Thailand and Viet Nam, and generated tens of billions of US dollars (FAO, 2016). However, many millions more people derive incomes and livelihoods from forests in other ways than traditional forestry. The region's forests provide a large variety of ecosystem services, timber and non-timber forest products, and homes for millions of people who depend on forests for their livelihoods and well-being.

Children at primary and secondary schools in AP have limited exposure to forests and to forest-related teaching, and to the kinds of jobs that the forest sector can offer (Brack, 2019). The benefits of outdoor learning and forest-school approaches for children's development and learning are increasingly well documented (see Kim and Choi, 2018 for a recent example from the Republic of Korea). However, there can be large differences among outdoor learning models and outcomes. Inoue *et al.* (2019) found, for example, that Japan's national guidelines on nature-based activities to promote child development "fall short on matters of global sustainability, environmental issues, environmental education, or education for sustainability". Inoue *et al.* (2019) also noted that there were limitations to the Australian guidelines in these areas and concluded that 'forest kindergartens' and Swedish *skogsmulle*[2] outdoor programmes offer more potential.

There are similar challenges at the TVET level. As noted by Gabay and Rekola (2019), TVET on forestry lacks practical training and field experience, teaching resources and career development opportunities such as internships. There is also a weak alignment of TVET courses with the needs of the job market, outdated curricula.

In many countries in the region, formal post-school forest education has its roots in colonial forest management and research (Jegatheswaran *et al.*, 2018; Bennett, 2011; Razak, Haron and Krishnapillay, 2005). The initial focus was often on research and practical training of foresters and field assistants. Recently, in Southeast Asia, five trends have been identified: (i) consolidation of traditional forestry programmes with other disciplines or termination of forestry programmes; (ii) increasing use of multidisciplinary approaches; (iii) increasing demand for generic skills and social aspects of forestry; (iv) e-learning and blended learning; and (v) internationalization (Li and Yuan, 2017). Several gaps between the competencies that forest education provides and what the job market needs have also been identified, such as the lack of skills in social forestry (Brack, 2019; Bhat, 2005; RECOFTC and AWG-SF, 2020). APFNet (2018) reported that there was a shift in forest education in the region from a resource-centred approach to a more integrated multidisciplinary approach, with stronger links to environmental science and international policy agendas, such as sustainable development. The APFNet report proposed cooperation and standardization within the region as solutions to pressures

[2] It is interesting to note that, coverage of forest planning and management was rated between social and cultural values and biophysical dimensions of forests.

from changes in labour markets, economies and policies that are changing the demands for forest education.

Europe

The Europe region in this assessment covers European countries, including the Russian Federation, as defined in FAO Forest Resources Assessment (FRA), and Türkiye from the Western and Central Asia countries. Europe has 25 percent of the world's forest area, and 46 percent of its land area is covered by forests (FAO, 2020). The countries with the highest percentage of their land in forest are Finland and Sweden, whereas the country with region's largest share of forest is Russian Federation, which has a forest area of 815 million ha (20 percent of the world's forest).

The forest sector accounts for around 1.0 percent of the region's gross domestic product (GDP). Europe produces and consumes very large volumes of a wide variety of forest products, and is also a net exporter of forest products to the world market. The concept of 'green jobs', introduced by the Forest Europe Ministerial Conference in 2015, is politically important. This concept embraces the region's wide range of forest environmental and social services, and the manifold opportunities for the forest sector to diversify its activities and income. It also embraces new opportunities for more inclusive and gender-balanced job creation. A concern facing this initiative is urbanization and the increased need to ensure quality working standards in order to attract people to work in rural areas to manage forests (Forest Europe, 2018), which is an issue for other rural economic sectors in the region such as agriculture.

In all countries of the European Union, for some decades, environmental education has been part of primary and secondary education as an independent compulsory subject, which is part of a compulsory subject area such as science, or as an interdisciplinary theme (Stokes, Edge and West *et al.*, 2001). Three main conceptual approaches are forest schools at the preschool and kindergarten level (Knight, 2013), forest pedagogy (Waller *et al.*, 2017) and learning outside the classroom (Waite, 2017).

TVET in Europe typically has a three-year duration. Moreover, learning through work in apprenticeships is also well organized, taking place in 24 out of 30 countries (CEDEFOP, 2018), and has a long tradition, especially in several Middle European countries such as Germany and Austria. Each country has its own TVET system. However, there is some cooperation, such as that organized by the European Credit System for Vocational Education and Training (ECVET). In addition, the European Centre for the Development of Vocational Training (CEDEFOP) is an EU agency for TVET, currently also promoting lifelong learning. Eurostat produces statistics on TVET covering a number of variables, such as the number of students per country.[3] Common trends have seen the expansion of the expected skills and, correspondingly, of the training programmes, and adaptation to social and technical developments in the area of mechanisation and logistics (Bernasconi and Schroff, 2011).

[3] Eurostat (2021).

University and college-level forest education in Europe has recently faced the challenge of students' decreasing interest in pursuing forestry careers (Pohlschneider and de Lima, 2017; Forest Europe, 2018, Gabay and Rekola, 2019). A change, also seen in the United States of America and some other countries, is a decrease in the number of independent forestry/forest sciences programmes. The major policy development is the European Union's harmonization process initiated in 1999, known as the Bologna Declaration of European Ministers of Education concerning higher education (www.ehea.info/pid34248/history.html). The basic framework consists of three cycles of higher-education qualifications: the three-year BSc, the two-year MSc and the four-year PhD. The framework uses the European Credit Transfer and Accumulation System. The Bologna process has encouraged more specialized programmes in tertiary forest education than in traditional forestry programmes (Schmidt *et al,* 2014; Lewark, 2016).

Latin America and the Caribbean (LAC)

About 23 percent of the world's forest cover is found in the Latin America and Caribbean (LAC) region, of which 97 percent is concentrated in South America, mainly in Brazil, which has 12 percent of the world's forests (Cordero, 2011; FAO and UNEP, 2020). In general, the region is characterized by its great diversity of flora and fauna, habitats and ecosystems. The management and conservation of forests in the LAC region remains a challenge, with just over 40 000 km^2 deforested each year (FAO and UNEP, 2020). The expansion of the agricultural (crop and livestock) frontier, mining, illegal logging, forest fires and armed conflicts are factors that threaten natural resources and the human populations that depend on them (Gabay *et al.,* 2020).

Recent studies show that the direct contributions of forests to economic development in the region are made mainly by the timber industry, especially from pulp exports. During 2016, about 22.2 million cubic metres of wood were exported, representing 0.45 percent of the region's GDP in that year (Quiroga, 2017). For most countries, the contribution of the timber industry to GDP and employment is less than 1 percent. However, 8 million people depend directly on the goods and ecosystem services provided by forests, whether as a source of energy (firewood), food, or the sale of non-timber products (Angelsen and Wunder, 2003; FAO, 2018; FAO and UNEP, 2020; Jiménez González *et al.*, 2017). FAO data estimate that most (82 percent) of the region's rural population live in poverty. Public policies that are specific to the forest sector have evolved to promote: sustainable forest management; the increase of protected areas; the restoration and reforestation of degraded areas; the strengthening of institutions; community participation; the inclusion of traditional knowledge in forestry plans; and more recently, climate change mitigation and adaptation (FAO, 2010; Keipi, 2000; Zanetti *et al.*, 2017).

Formal forest education programmes in LAC were created just over 60 years ago in response to the growth in demand for wood, pulp and paper. During this period, FAO has conducted three evaluations of forestry at the technical, undergraduate and graduate levels, carried out with the collaboration of some universities (Shirley and Llauradó,

1969; Malleux, 2014). The latest evaluation included a proposed profile of the forestry engineer defined as follows:

> *the forestry engineer is a professional with scientific, technical, humanistic and ethical training who has the ability to manage processes of sustainable use of forest ecosystems for the benefit of society, through the organization and/or management of public and private entities, as well as own entrepreneurship, efficiently influencing the value chain of forest production. Similarly, it participates in the development and implementation of policies aimed at the management of forests, wildlife, protected natural areas and forest plantations* (Malleux, 2014).

However, no region-wide overview of forest education at the primary and secondary levels is available in the published literature.

North America (NA)

The great diversity of forests in North America (NA), which includes conifers and broad-leaved tree species in various combinations, is due mainly to two strong gradients: a temperature gradient from south to north that spans the gap between semi-tropical forests in the south to boreal forests in the north; and a moisture gradient from east to west, resulting in moist temperate forests in the east giving way to dry temperate forests, and in turn, savannas, and finally shrublands and grasslands in the west. Several mountain masses exhibit these same gradients over relatively short geographical distances. Canada has 9 percent of the world's forests and is the third most forested country in the world with 347 million ha of forest (34 percent of the country) (Natural Resources Canada, 2019a). At 333 million ha, forests and woodlands comprise 36 percent of the land base in the United States (Oswalt *et al.*, 2019). The United States has the highest level of roundwood consumption per capita, fed by an industry that accounts for 17 percent of roundwood production globally. Wood also plays an increasingly important role in meeting the nation's energy demands, accounting for the production of 20 percent of renewable energy and 41 percent of bioenergy (Oswalt *et al.*, 2019).

In the United States, federal policy, regulations and strategic plans specific to forest-based education at the primary and secondary levels are centralized. The U.S. Forest Service (USFS), with a myriad of other federal agency stakeholders also involved through broader and more comprehensive environmental or conservation education programmes. In Canada, the Council of Ministers of Education, Canada (CMEC), an intergovernmental body founded in 1967 by the provincial ministers of education, "provides leadership in education at the pan-Canadian and international levels" (CMEC, n.d.). Although CMEC does not set curricula, it does provide a general direction for education in the country.

Project Learning Tree (PLT) is the leading non-profit initiative for national policy and programming with respect to forest-based education in the United States and Canada. It is the only national non-profit with a mission dedicated to providing high-quality forest-related supplemental curricula and professional development for youth educators at the pre-kindergarten, elementary, secondary and tertiary levels. PLT deploys programmes through state and provincial-sponsored programmes that tailor the application to local

needs. State sponsors include forestry associations, environmental NGOs, and academic institutions. In addition to state programmes, national PLT coordinates with local, state, federal and other non-profit partners with an interest in improving forest and environmental literacy nation-wide (PLT also partners with NGOs in Canada, Brazil, Japan, Mexico, and Uruguay to deliver its high-quality curriculum and professional development).

Policies related to forest education at the college/university and TVET levels vary by provinces in Canada and states in the United States of America. At these levels, schools are entitled to determine curricula in accordance with degree quality standards established by authorities. Accreditation systems contribute to harmonization in the United States (Society of American Foresters; and U.S. Department of Education and/or the Council for Higher Education) and Canada (the Canadian Forest Accreditation Board, and at the TVET level, also the Canadian Technology Accreditation Board).

TVET in the NA region is diverse and takes place at the lower (i.e. secondary) and college levels (UNESCO-UNEVOC, 2013; Zirkle and Martin, 2012). TVET enables its participants to develop skill sets that are needed in the workplace and that meet the needs of the provinces/states. Education can be delivered through vocational courses, either in specialized schools or as optional programmes in schools with vocational streams, or in the form of apprenticeship programmes (FPSC, 2012). Graduates from TVET programmes may earn specific certificates at the end of the programme (Zirkle *et al.*, 2007). For example, before loggers start to work in forests, they are required to obtain a certificate showing that they have passed the safety training (Helmkamp *et al.*, 2004; Kim *et al.*, 2017). At the post-secondary levels, TVET can also be provided by technical, vocational institutions and colleges, which are generally publicly funded.

Radical changes in the forest sector in the last several decades have been driven primarily by emerging global trends in social, economic and environmental issues (Innes, 2005). Changes in forest industry and the public's interest in conservation are reflected in undergraduate degree programme trends in the NA region. Programmes are becoming more holistic in their approach, including those focused on land management and human impacts on the landscape. Enrolments in traditional forestry programmes have declined (Canada) or increased only slightly (United States of America) over the past few decades (Innes *et al.*, 2018; Sharik *et al.* 2015; 2019). The greatest growth in Canada has been seen in urban forestry and conservation programmes, and in the United States in natural resources conservation and management, and environmental science and studies programmes.

The overall enrolment in graduate programmes in Canada increased from 2001 to 2019, the emphasis being on research-based programmes (AUFSC, 2019). In the United States, graduate enrolment in Natural Resources and Conservation (NRC), consisting of eight academic areas (including forestry), has generally been decreasing since 2010 (Sharik *et al.*, 2019). The proportion of racial/ethnic minority and female undergraduate and graduate enrolment has been increasing since 2005, mostly in the broader interdisciplinary programmes (Sharik *et al.*, 2015; Sharik *et al.*, 2019).

Near East and North Africa (NENA)

The Near East and North Africa (NENA) region stretches from the Atlantic coast of Mauritania and the southern shores of the Mediterranean Sea, across the northern part of Africa and eastwards over the Arabian Peninsula. The region is considered one of the driest in the world and the least endowed with forests resources. The forest cover in the region is estimated at 42 million ha, equivalent to 3.0 percent of the region's land area, while other wooded land is estimated at 35.4 million ha (FAO, 2020). Both forests and other wooded land represent 5.4 percent of the land area of the region (FAO, 2020). Trees outside forests, considered an integral part of agriculture, are an important natural resource that contributes substantially to biomass and carbon stocks, and to people's livelihoods. Some countries do not have natural forests. Tree planting in the region is largely driven by the demand for wood and non-wood forest products, and the need for ecosystem services, including environmental protection. Major forest industries in the region are very limited.

Most countries in the region have an insufficient number of forestry personnel at all levels. And yet, there are far fewer job opportunities for forestry graduates compared to graduates in other fields, such as agriculture. This paradox is due to deficiencies in forestry training and problems of state forest organizations, which are the main employers in the region.

In most countries of the NENA region, tertiary education is under the Ministry of Higher Education, while primary and secondary education are under the Ministry of Education at the local or provincial level. Local governments/provinces are responsible for the delivery of basic schooling. Universities currently develop their curricula in collaboration with stakeholders, following guidance from the Ministry of Higher Education.

In an FAO paper, a number of concerns regarding forest education and research in the region were highlighted (Hamid, 2015). The top five priorities, which are common in the four countries considered, were academic staff, curriculum development, physical resources, sectoral coordination, and students.

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3. Survey methods and responses

3.1. SURVEY METHODOLOGY

This assessment report summarizes the analysis of the Global Survey on Forest Education carried out by the Global Forest Education Project. Taking into account the aims of the assessment and the frame of reference, the project team and RLPs created questionnaires that cover a range of topics including: education content and competencies; teaching approaches; educational resources and policy; workplace readiness and employability of TVET and university and college students and recent graduates; digital readiness for secondary, TVET and university and college students; and general development and trends in TVET and university and college education.[4] Most of the questions applied a semantic differential scale in which several response options were provided to choose from. Some questions were open-ended, permitting the respondent to provide a written response. The survey questionnaires were translated by RLPs and made available in 14 languages. Webropol, an online survey and reporting tool, was used to dispatch the surveys and manage the data received (Webropol.com). The procedures adhered to European Union security, ethics and data processing protocols.

Three different questionnaires were created, one for each of the following target groups:

1. *Professionals.* Forest professionals working in government organizations, business organizations (the private sector), labour unions, forest owners' associations, and environmental and other non-governmental organizations (Questionnaire 1).
2. *Teachers.* Teachers and administrators in primary schools, secondary schools, TVET institutions, and universities and colleges (Questionnaire 2).
3. *Students.* Enrolled or recently graduated students of forestry and forest-related programmes in TVET schools and in universities and colleges (Questionnaire 3).

Sampling of the target groups consisted of two sampling strategies. First, *statistical samples* were drawn to represent countries and target groups in each the region. This strategy was supplemented with s*nowball sampling*, which was applied by sending an open invitation to take the survey through social media channels, such as Twitter; promoting the survey using the Global Forest Education hashtag (#globalforesteducation)

[4] Education content and competences were an essential element of the survey. They included more than 20 items, the exact number depending on the level of education. The approach was designed to measure the gap in teaching and learning between desired and actual levels, using the wording, "To what extent are the following topics and skills covered in education?" This gap analysis and the way the questions were formulated assumes that respondents take into account at the same time the importance of topics and skills, their teaching and learning methods, and learning outcomes. Due to a large number of elements in the survey, it was not possible to measure these items separately. To add a measure, for instance, on "the importance of these topics and skills" would have made the survey far too long (see gap analysis, for example, in Arevalo *et al.*, 2012).

and through web stories prepared by the partners; sending survey announcements to project partners' membership or contact lists; and encouraging survey respondents to forward the survey invitation to their contacts, networks and colleagues.[5]

3.2 RESPONDENTS

The analyses of survey data were based on a total of 2 741 responses received from online surveys, combining respondents in both statistical and snowball samples (Table 1). Respondents were relatively evenly distributed between target groups, professionals (n=968), teachers (n=963) and students (n=840). However, there were large differences between regions in the number of respondents, especially the NENA region, which had far fewer respondents than the other regions.

TABLE 1.
Respondents by target group (statistical sampling bolded) and regions and countries (snowball sampling)

	Professionals	Teachers	Students	Total	Percentage of total (%)
1 Africa (AF)	136	117	129	382	14
2 Asia and the Pacific (AP)	180	145	113	438	16.2
3 Europe	170	173	118	461	17
4 Latin America and the Caribbean (LAC)	274	333	289	896	32
4 Near East and North Africa (NENA)	34	36	5	75	2.8
6 North America (NA)	144	159	186	489	18
Total	968	963	840	2 741	100.0

Table 2 shows the number of respondents per respondent category and per each level of education. Professionals were asked to choose the level(s) of education that they felt they were most qualified to assess. Since many of them responded to questions about two or more levels, the sum of the number of professional respondents exceeds the number of professional respondents.

[5] See, for instance, FAO's web story upon the release of the survey on 15 July 2020. www.fao.org/forestry/news/97465/en

TABLE 2.
Numbers of survey respondents for each level of education

	Primary	Secondary	Technical and vocational education and training	Associate's	bachelor's	Master's / PhD	All levels*
Africa							
Professionals	61	60	67	10	63	64	19
Teachers	12	23	32	1	55	24	0
Students	0	0	6	5	70	42	0
Asia and the Pacific							
Professionals	77	74	67	6	71	55	26
Teachers	17	24	14	00	65	43	0
Students	0	0	3	0	60	41	0
Europe							
Professionals	99	84	49	0	45	70	35
Teachers	21	27	43	0	30	85	0
Students	0	0	7	0	30	75	0
Latin America and the Caribbean							
Professionals	113	109	86	19	126	79	66
Teachers	38	52	38	15	189	70	0
Students	0	0	15	5	189	30	14
Near East and North Africa							
Professionals	16	12	15	0	15	12	5
Teachers	8	10	5	0	10	3	0
Students	0	0	0	0	4	1	0
North America							
Professionals	91	90	53	13	65	42	12
Teachers	27	26	15	6	43	31	0
Students	0	0	6	2	93	55	0

Note: "All levels" responses are from the professionals' questionnaire (Q1), and they consider evaluations of all university levels at the same time, including associate's, bachelors', master's and PhD.

Table 3 shows the gender, ethnicity and age distribution of respondents. Overall, the majority (59.7 percent) of the respondents were male, but among students, the majority (51.4 percent) of the respondents were female.

TABLE 3.
Sociodemographic characteristics of the respondent groups: professionals, teachers, and students

Baseline characteristic	Professionals (Q1)		Teachers (Q2)		Students (Q3)		Full sample	
	n	%	n	%	n	%	n	%
Gender								
Male	578	62.1	649	68.9	350	45.5	1 577	59.7
Female	324	34.8	277	29.4	395	51.4	996	37.7
Other	29	3.1	16	1.7	24	3.1	69	2.6
Total respondents	931	100.0	942	100.0	769	100.0	2 642	100.0
Racial/ethnic group								
Majority	592	64.2	638	68	434	56.6	1 664	63.4
Minority	104	11.3	69	7.4	116	15.1	289	11
Non-applicable	142	15.4	131	14	141	18.3	414	15.8
Prefer not to say	84	9.1	99	10.6	76	10	259	9.8
Total respondents	922	100.0	937	100.0	767	100.0	2 626	100.00
Age group*								
18–20 years			2	0.2	85	11	87	5.1
21–24 years			4	0.4	305	39.5	309	18.1
25–29 years			23	2.5	214	27.7	237	13.9
30–40 years			204	21.7	134	17.3	338	19.8
41–54 years			368	39.2	29	3.8	397	23.2
55–64 years			264	28.1	5	0.6	269	15.7
65+ years			69	7.4	0	0	69	4
Choose not to answer			4	0.4	1	0.1	5	0.2
Total respondents			938	100.0	773	100.0	1 711	100.0

*Professionals were not asked to report their age.

Students at TVET and university and college levels were asked to report the country in which they were studying (Table 4). Most of respondents (between 53 and 83 percent, depending on the region) reported that they were studying in their home country. Between 2.6 and 25.5 percent of students reported that they studied in a foreign country aiming to receive a degree or as an exchange student. The percentage was highest in the Europe region and lowest in the LAC region.

TABLE 4.
Students' current or planned place of studies

Africa	n	%
Home country	83	64.8
Foreign country (exchange studies)	0	0.0
Foreign country (degree studies)	8	6.3
Not studying currently	37	28.9
Total	128	100.0

Asia and the Pacific	n	%
Home country	79	71.2
Foreign country (exchange studies)	1	0.9
Foreign country (degree studies)	13	11.7
Not studying currently	18	16.2
Total	111	100.0

Europe	n	%
Home country	62	53.0
Foreign country (exchange studies)	3	2.6
Foreign country (degree studies)	28	23.9
Not studying currently	24	20.5
Total	117	100.0

Near East and North Africa	n	%
Home country	5	100.0
Foreign country (exchange studies)	0	0.0
Foreign country (degree studies)	0	0.0
Not studying currently	0	0.0
Total	5	100.0

Latin America and the Caribbean	n	%
Home country	211	83.1
Foreign country (exchange studies)	0	0.0
Foreign country (degree studies)	5	2.0
Not studying currently	38	15.0
Total	254	100.0

North America	n	%
Home country	106	67.1
Foreign country (exchange studies)	1	0.6
Foreign country (degree studies)	25	15.8
Not studying currently	26	16.5
Total	158	100.0

Professionals were asked to indicate the name of the organization for which they were working; almost half of them (47.2 percent) reported that they worked for a governmental organization (Table 5). The second highest share of respondents worked for environmental and other NGOs.

TABLE 5.
Workplace background of the professionals

Organization	Professionals	
	n	%
Governmental organization	466	47.2
Business organization	108	10.9
Labour union	7	0.7
Forest owners' associations	41	4.2
Environmental and other NGOs	251	25.4
Other	114	11.6
Total	987	100.0

4. Survey results

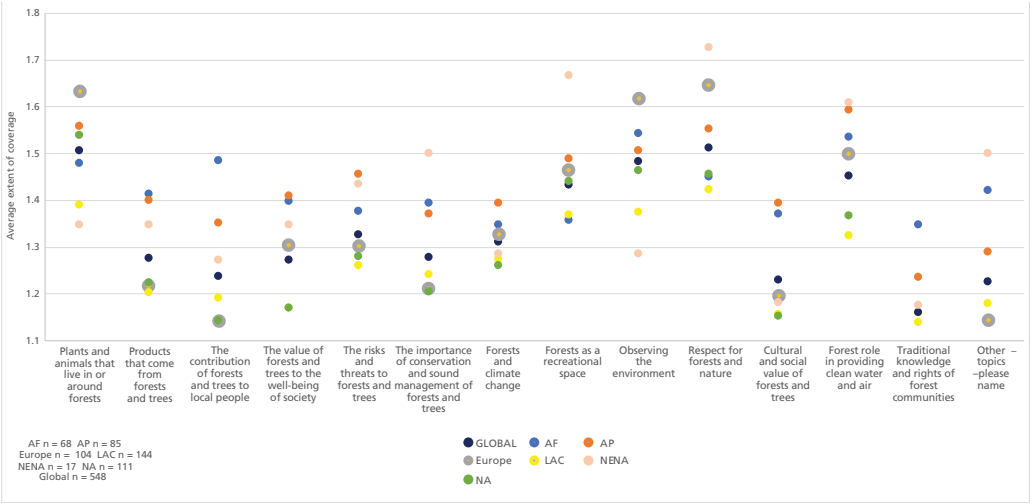
4.1. PRIMARY EDUCATION

The survey questionnaires on forest education at the primary level included the following topics: forest-related curriculum content and teaching competencies, teaching approaches, skills that forest education provides to pupils, teaching approaches, and educational resources and policies.

4.1.1 Education content and competencies in primary education

Education content mainly manifested in curricula provides a basis for teaching and learning to develop the competencies of students. The semantic scale used for questions posed to professionals and teachers was as follows: 1 = inadequately covered, 2 = sufficiently covered, and 3 = excessively covered. Regional averages of professional and teacher responses are shown in Figure 4. A value below 1.5 indicates that the majority of respondents considered the topic to be inadequately covered. Globally, the only subjects considered adequately covered were plants and animals that live in or around forests, and respect for forests and nature.

Figure 4. Topics and skills covered in primary education


Average extent of coverage
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
Plants and animals that live in or around forests
Products that come from forests and trees
The contribution of forests and trees to local people
The value of forests and trees to the well-being of society
The risks and threats to forests and trees
The importance of conservation and sound management of forests and trees
Forests and climate change
Forests as a recreational space
Observing the environment
Respect for forests and nature
Cultural and social value of forests and trees
Forest role in providing clean water and air
Traditional knowledge and rights of forest communities
Other – topics –please name
AF n = 68 AP n = 85
Europe n = 104 LAC n = 144
NENA n = 17 NA n = 111
Global n = 548
GLOBAL
AF
AP
Europe
LAC
NENA
NA

Note: Scale: 1 = inadequately covered, 2 = sufficiently covered, 3 = excessively covered

All other forest-related topics and skills were considered inadequately covered at the primary level globally. In some regions, all topics were considered to be inadequately covered. The topics considered the least well covered across all regions were the cultural and social value of forests and trees, traditional knowledge and rights of forest communities, and the contribution of forests and trees to local people. The highest average global scores were given to plants and animals that live in or around forests, and respect for forests and nature.

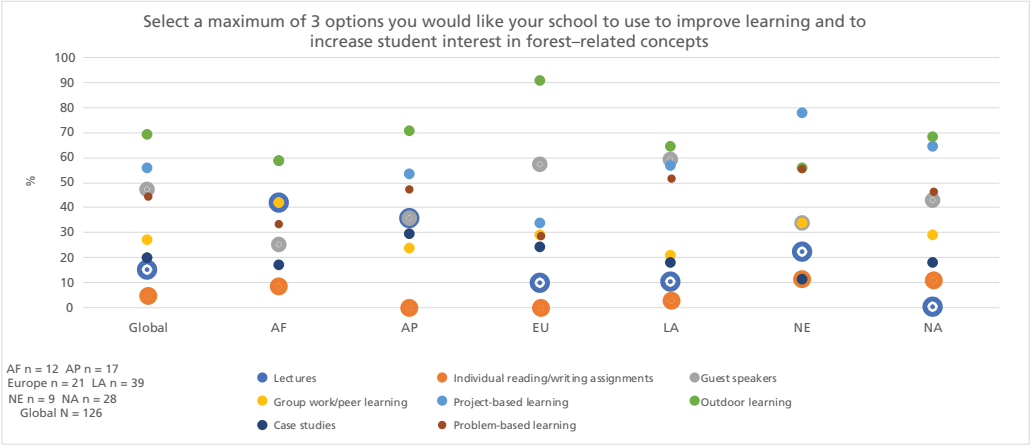
Variation across regions was high. Some of the region-specific results were as follows. In Africa (AF), the majority of respondents reported that forest-related topics were *not at all* or only *to a limited extent* included in other subjects in the curriculum. In the LAC and NA regions, especially low ratings were given to cultural and social values of forests and traditional knowledge, and rights of communities. Across all regions, the highest values for the coverage of any topics were given in the NENA region to forests as a recreational space, and respect for forests and nature.

4.1.2 Teaching approaches in primary education

Concerning students' interest in studying forest-related topics, primary education teachers were asked to select the most common teaching approaches used in their school to teach forest-related concepts. They were also asked to reflect on the three teaching approaches that they would like to use in their teaching in order to improve students' learning and to increase their interest in forest-related concepts.

The most commonly used teaching approaches reported in the survey across regions were lectures. In several regions, outdoor learning was used very little, whereas in Europe and NA, it was a highly preferred teaching approach. Regarding the question on which teaching approaches would increase students' learning, outdoor learning was the most preferred method in all regions except in the NENA region, where project-based learning was the most preferred. The second most preferred method was project-based learning, except for in the NENA region, while the least preferred method was individual reading/writing assignments, except for in the NA where it was lectures (Figure 5).

Figure 5. Recommended teaching approaches to improve learning and increase students' interest in forest-related concepts at the primary level



Respondents were also asked to report, in their own words, actions that would have the greatest impact on improving primary students' knowledge and appreciation of forests and forest-related topics. Here again, outdoor learning dominated the responses (Table 6). Some region-specific items were highlighted, for instance, tree growing (AF) and non-wood industry (AP), value chains through the use of products made from wood (Europe), and interpreting forest data (NA).

TABLE 6.
Actions that would have the greatest impact on improving primary students' knowledge and appreciation of forests and forest-related topics

Region	Region-specific actions
AF	Setting up environment clubs; involving students in tree growing
AP	Organizing field trips, particularly to forests but also to other sites such as wood-processing industries; planting trees and visiting non-wood products industries
Europe	Introducing students to value chains of forest products; conducting weekly visits to forests; providing training sessions for teachers
LAC	Inviting experts to give lectures; involving students in project-based learning
NA	Scheduling outdoor time; involving students in forest associations that provide learning opportunities; interpreting forest data
NENA	Involving students in project-based learning, outdoor learning and problem-based learning activities.

4.1.3. Educational resources and policy in primary education

Professionals and teachers were asked about the availability of educational resources and the existence of policies or strategies for improving forest education at the primary level. Responses from both respondent groups were aggregated and then disaggregated by region. The responses were summed to provide a global value (Figure 6).

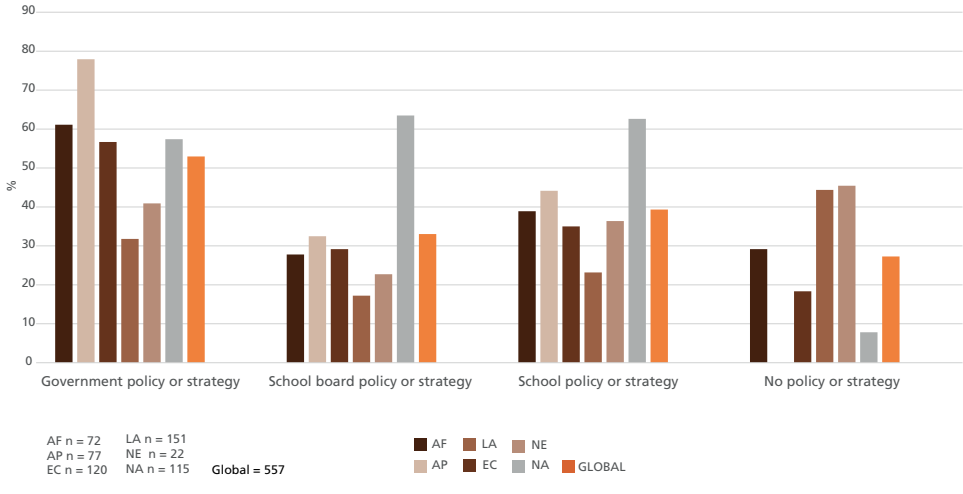
In general, most professional and teacher respondents indicated limited access to teaching resources, learning materials and practical learning opportunities. The resource considered to be the most lacking in most regions was a conducive educational environment, such as laboratory access. Based on the regional report in the Europe region, most respondents of both groups reported that the resources for forest education were only *moderately* available. Concerning the availability of learning materials, teachers' perceptions in the Europe region were polarized. In the AF region, a conducive educational environment (e.g. laboratory access, class sizes) was reported as lacking in many primary schools. According to the AP region report, considerably more teachers than professionals stated that resources were *moderately* or *very much* available. The availability of resources was seen to be the highest in the NA region.

Figure 6. Availability of forest education resources in primary schools

Scale: 1= *not at all*, 2= *to a limited extent*, 3= *moderately*, 4 = *very much*.

Most respondents said that there were government policies or strategies that could improve forest education in primary-level education, but regional differences were evident (Figure 7). Most respondents in the LAC and NENA regions, contrary to those in other regions, stated that there were no clear policies or strategies for primary-level forest education.

Figure 7. Perceptions on the availability of policies or strategies for improving forest education at the primary level



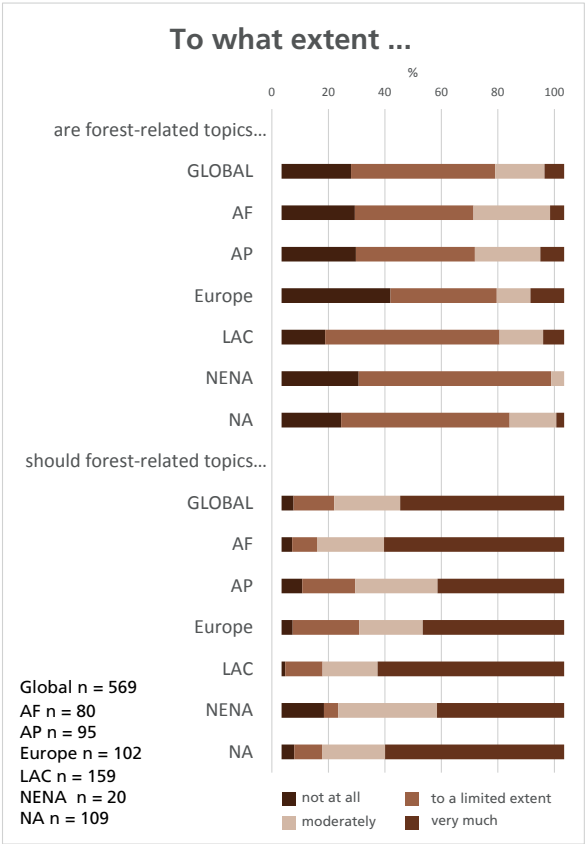
4.2. SECONDARY EDUCATION

4.2.1. Education content and competencies in secondary education

Most professionals and secondary education teachers reported that forest-related topics were not currently included in the curriculum as *individual* subjects but they felt they should be (Figure 8). The respondents were also asked whether forest-related topics were, or should be, included in *other* subjects in the curriculum. Both professionals and secondary education teachers reported that forest-related topics were included in *other* subjects only *to a limited extent*. The majority of both respondent groups agreed that they should be included in *other* subjects.

Figure 8. Level of forest-related topics included in the secondary school curriculum and level of interest in incorporating forest-related topics into the school curriculum

Responses of professionals and teachers are aggregated regionally



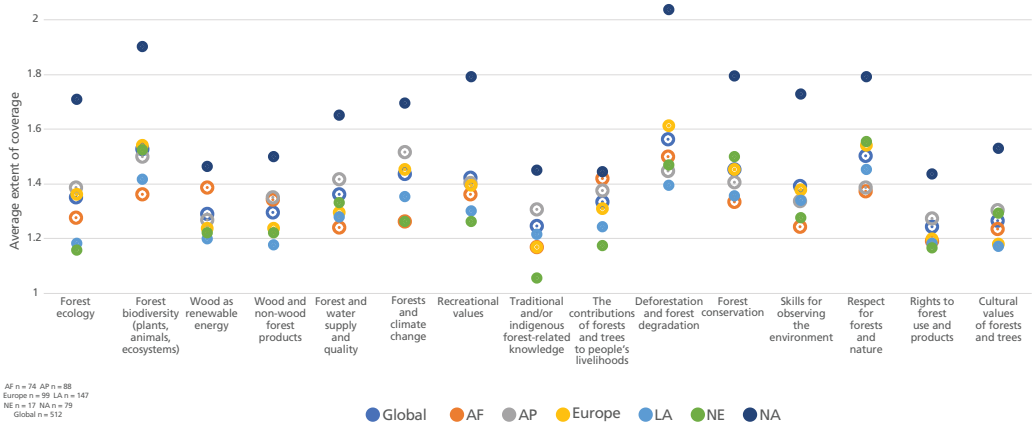
Note: Responses of professionals and teachers are aggregated regionally.

Regarding the content of the secondary education curriculum, professionals and teachers were asked to evaluate the extent to which 13 forest-related topics and skills were covered in secondary education (Figure 9). There were some differences between the perceptions of teachers and professionals, but, in general, both respondent groups considered the topics and skills at the secondary level on average to be inadequately covered. Globally, topics and skills that were considered better covered than others, albeit not sufficiently, were forest biodiversity, deforestation and forest degradation, and respect for forests and nature.

Some region-specific issues emerged on whether forest-related topics should be included in the curriculum individually or included in other subjects. In the AF region, respondents identified a long list of topics that should be included in the curriculum as

individual subjects. In the AP region, both groups of survey respondents wanted to see forest-related topics as individual subjects to a far greater extent than they currently were. Most of these respondents said that there should be some kind of course subject with "forest" in its name. In the Europe region, perceptions differed between professionals and secondary education teachers on whether forest-related topics were included in the curriculum as individual subjects. Unlike teachers, most professionals felt that forest-related topics were not, or were only *to a limited extent*, included in the curriculum as individual subjects. Survey participants in the LAC region indicated that scant attention was paid to forestry topics in secondary school curricula, both in individual topics and as additional content in other subjects. Respondents felt that it was possible to integrate forest subjects such as production chains and calculation of wood volumes into other subjects such as mathematics, history, and natural sciences and the environment. LAC and NA figures were the lowest on average among all regions

Figure 9. Topics and skills covered in secondary education



Notes: Scale: 1 = *inadequately covered*, 2 = *sufficiently covered*, 3 = *excessively covered*.
Responses of professionals and teachers are aggregated regionally.

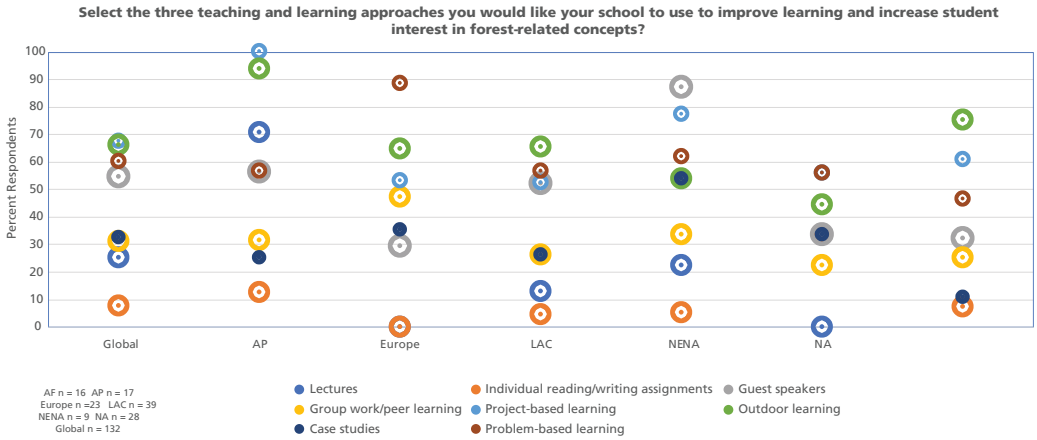
4.2.2. Teaching approaches in secondary education

Respondents were asked about the extent to which forests were used as a teaching environment or classroom in schools. Globally, few respondents felt that forests were either *very much* or *moderately* used as a teaching environment at the secondary level. In some regions, the usage was reported as almost non-existent. Both professionals and teachers still argue that when students engage in forest-related activities outdoors during school hours or outside of school, their knowledge and appreciation of forests increase.

Outdoor learning and project-based learning were highly recommended to improve learning and increase student interest in forest-related concepts in secondary education

(Figure 10). The least preferred methods reported were individual reading/writing assignments. It should be noted that this question had only a limited number of respondents (from 9 to 39 per region), a fact that reduces the reliability of the results.

Figure 10. Recommended improvements to learning and increased student interest in forest-related concepts in secondary education



Regional differences are worth noting. In the AF region, forests were used to only a limited extent as a teaching environment or classroom. About four-tenths of teachers and one-fourth of professionals reported that forests were not used at all as teaching environment or classroom. In the AP region, the dominant teaching methods reported by teachers were lectures, individual writing and reading assignments, and guest speakers. Teachers from the Europe region reported outdoor learning and group working/peer learning to be the most common methods to teach forest-related topics. This result is unique among regions. LAC respondents reported that forests were used as a classroom to only a limited extent, while some planned activities took place outside the school, such as visits to botanical gardens and orchards, field trips, ecological walks in peri-urban forests, park clean-ups and camping. However, although these activities are limited, survey participants considered them crucial to increase knowledge and appreciation of forests. In the NA region, more than 80 percent of professionals and teachers reported having limited exposure to forests through school activities.

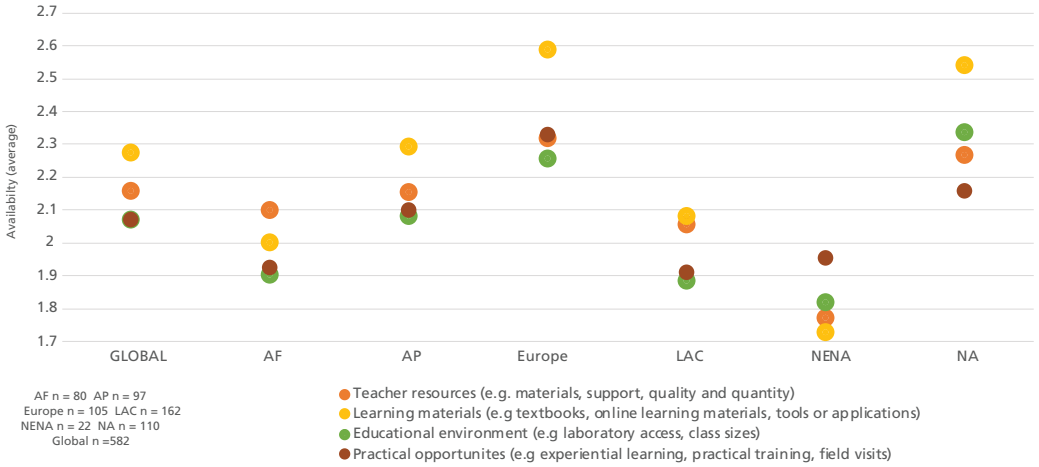
4.2.3. Educational resources and policies in secondary education

Professionals and teachers were asked about the availability of educational resources and the existence of policies or strategies for improving forest-related education at the secondary level. Responses from both respondent groups were aggregated then disaggregated by region. The responses were summed to provide a global value.

In general, respondents stated on average that forest-related educational resources of all kinds were limited in their availability. The exceptions to this were the Europe

and NA regions, where learning materials were considered *moderately* available on average (Figure 11).

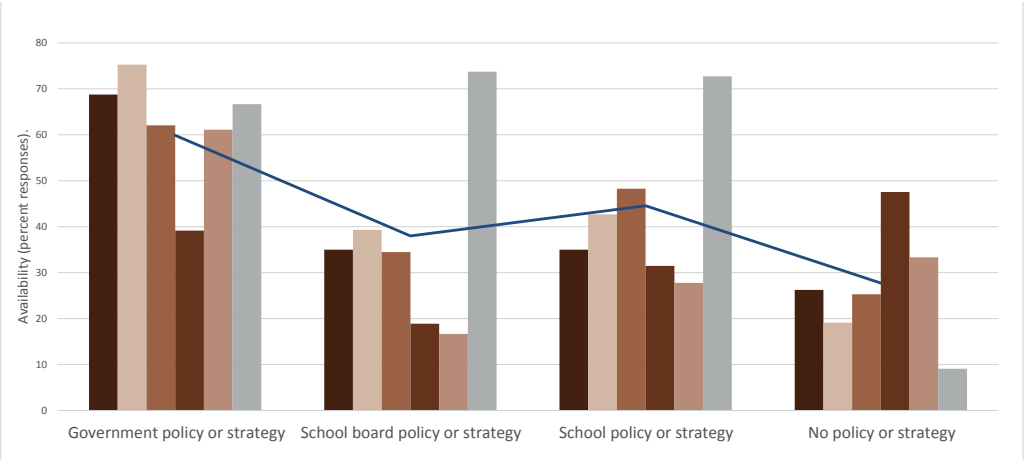
Figure 11. Availability of forest education resources in secondary schools



Note: Scale: 1= *not at all*, 2= *to a limited extent*, 3= *moderately*, 4 = *very much.*

The majority of respondents on a global scale stated that there were governmental policies or strategies in place for secondary-level forest education (Figure 12). The biggest regional differences were related to school board and school administration policies and strategies. Contrary to other regions, where less than half the respondents believed that such policies and strategies did not exist, nearly three-fourths of the respondents from NA thought they did. The LAC region was reported to have the lowest availability of policies and strategies by the government, school board and schools.

Figure 12. Perceptions concerning the existence of policies or strategies leading to improved forest-related curricula in secondary schools

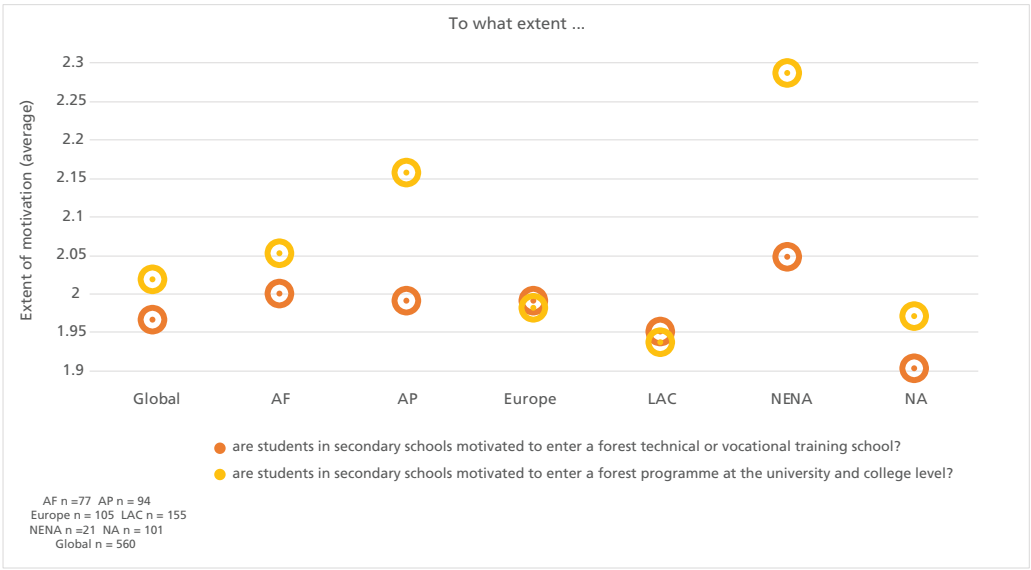


4.2.4. Readiness for forest education after secondary education

In general, respondents felt that secondary education stimulated students‘ interest in continuing their learning about forests or related topics to only a limited extent. Secondary school students were less interested in entering a TVET programme in forestry than a forestry programme at university or college-level (UC) education (Figure 13).

There were a few exceptions to the global results. In the AP and NENA regions, differences between TVET and UC were exceptionally high, with secondary education students much more likely to be motivated to enter a forest programme at the college or university level than a TVET forestry programme. Students’ motivation to enter a forest technical and vocational training school was considered lowest in the NA region. Motivation of secondary school students to enrol in a university or college-level forest programme was lowest in the LAC region.

Figure 13. Student motivation for entering higher-level forest courses or programmes following secondary education



Note: Scale: 1= not at all, 2= to a limited extent, 3= moderately, 4 = very much; professional and teacher responses combined.

4.3. TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING

4.3.1. Education content and competences in technical and vocational education and training

Professionals, teachers and students were asked to evaluate the extent to which 41 forest-related topics and skills grouped under six themes were covered in TVET. The semantic differential scale used in the questions and the analysis are similar to those described in the sections concerning primary and secondary education (see sections 4.1.1 and 4.1.2). With the exception of the AF region, very few student responses at the TVET level were received. Thus, the following results represent mainly perceptions of professionals and teachers.

Both respondent groups considered that topics and skills at the TVET level were covered on average inadequately or sufficiently, but mostly the latter (Figure 14). Other skills together with forest resources and forest ecology received the highest global average scores, while forest services and cultural issues received the lowest scores, even though NA respondents rated this theme very high in terms of coverage.

Figure 14. Topics and skills covered in technical and vocational education and training

Note: Scale: 1 = *inadequately covered*, 2 = *sufficiently covered*, 3 = *excessively covered*.

Some regional differences were more apparent when looking at the responses to questions about adequacy of coverage of the 41 forest-related topics (Figure 14). In the AF region, topics of forest biodiversity (plants, animals, ecosystems), forest soils, forest ecology, wood and non-wood forest products, forest planning, and silviculture were reported to be sufficiently or excessively covered. In the AP region, a large proportion of respondents thought coverage was inadequate for all topics. This proportion ranged from around 30 percent to over 70 percent of the professionals, and 90 percent of the teachers. Professionals and teachers in the Europe region perceived the topics of silviculture and forest planning to be sufficiently or even excessively covered. In the LAC region, topics related to the forest resources and forest ecology theme were sufficiently covered. However, there were very different opinions among respondents regarding the topics of landscape restoration, grassland management, sustainable harvesting systems, agroforestry, and watershed management. This underlines the need to tailor curricula to national and sub-national circumstances and needs.

4.3.2. Educational resources and policy in technical and vocational education and training

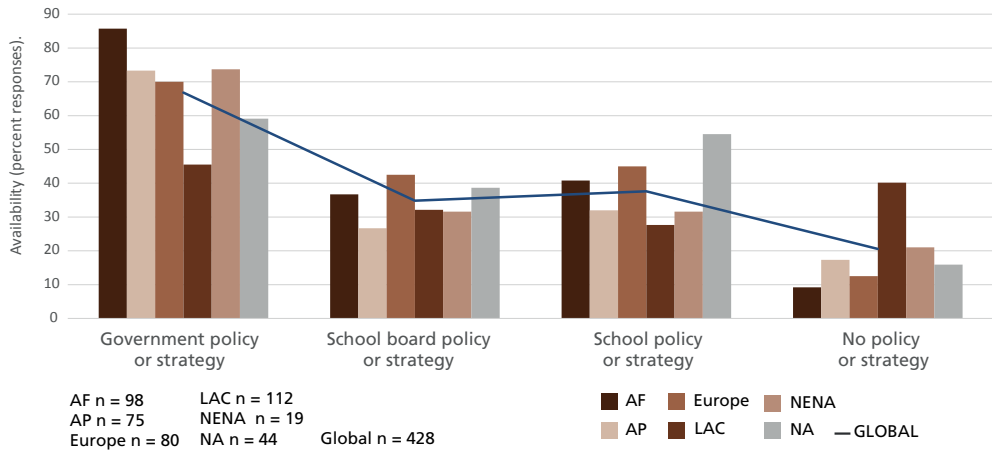
Professionals and teachers were asked about the availability of educational resources and the existence of policies or strategies for improving forest-related education at the TVET level. In general, respondents stated that forest-related educational resources of all kinds were of limited availability. There are some fundamental differences in resources across regions.

In the AF region, most resources to support TVET were reported as non-existent or limited in extent. These resources included teachers (quality and quantity), learning materials (e.g. textbooks, online learning materials and tools), educational environment

(e.g. laboratory access, class size), and practical opportunities (e.g. experiential learning, practical training). Similar results were seen in the AP region. Professionals' and teachers' perceptions were different regarding teacher resources. In the LAC region, it was widely stated that resources were not sufficient, infrastructure was poor, and opportunities for internships were limited. Unlike other regions, most teachers in the Europe and NA regions reported that all resources were at least *moderately* available. However, in contrast to NA, less than half of the professional respondents held this view in Europe.

In all regions, both professionals and teachers considered that government policies and strategies were the most common type of policy or strategy leading to improved forest-related education at the TVET level (Figure 15). In the NA region, the availability of school policies or strategies nearly equalled that of government policies and strategies. In all regions, only a few respondents stated that no policy or strategy existed, with the exception of the LAC region, where four out of ten had this perception

Figure 15. The availability of policies or strategies for improvement of forest-related education at the technical and vocational education and training level



Note: Availability is indicated by "moderately" and "very much" responses, which are summed up.

4.3.3. Workplace readiness and employability in technical and vocational education and training

Respondents were asked to evaluate how well TVET forest programmes prepared students to enter the workforce. In most regions, respondents were *moderately* satisfied in this regard. An exception was the LAC region where respondents were satisfied to only *a limited extent*.

Employment opportunities for TVET graduates varied among regions. They were considered limited in the AF, AP and LAC regions. Figures were not provided in the regional assessment reports for Europe, NA and NENA.

Gender and race and/or ethnicity were identified as issues in employment in several regions. In the AF region, cultural and ethnic biases were perceived to affect the types of jobs forest TVET graduates were offered. In the AP region, more female than male respondents indicated that student's gender was *moderately* or *very much* a factor in a graduate's ability to find a job. Teachers and professionals in the AP region indicated that race/ethnicity was less of a factor than gender in graduates' ability to find a job and the types of jobs offered. In the Europe region, many teachers thought that gender was a strong factor affecting graduates' employment prospects, whereas only a very few professionals and teachers perceived race/ethnicity as an influencing factor. In the NA region, impacts of gender and race/ethnicity on graduates' ability to find forest-related jobs were considered moderate to high by professionals and students, whereas teachers felt that these factors had very little effect on graduates' ability to find forest-related jobs.

In some regions, the number of responses regarding workplace readiness and employability was low, especially in student surveys. In fact, the number of TVET student responses to all questions was low.

4.3.4. Digital readiness in technical and vocational education and training

Perceptions of digital readiness in TVET education varied greatly among regions. In the AF, AP and LAC regions, respondents felt on average that digital tools were used only to a limited extent, whereas those in the Europe and NA regions felt that they were used to a moderate extent. However, in most regions, respondents believed strongly that digital tools could be a valuable supplement to forest education at the TVET level.

4.3.5. General developments and trends in technical and vocational education and training

Generalizations about the perceptions of TVET enrolment trends over the past decade are difficult to make because responses from most regions were nearly equally balanced among the choices of decreasing, stable and increasing. The NA region may be the exception, where enrolments were more consistently thought to be stable or decreasing.

Regional assessments reported some factors related to the quality of TVET on forestry education worthy of particular attention. In the AF region, a key factor identified as contributing to the reduction in the quality of quality of TVET on forestry was the lack of employment opportunities for forest graduates, which discouraged high quality students from enrolling. In the AP region, some respondents cited improvements in infrastructure, equipment, machinery, information technology, human capacity, and curriculum content, a mandatory requirement for certified skills, and quotas for people from forest communities to study forestry as factors responsible for increasing the quality of forest TVET. Factors cited as responsible for reducing the quality of forest TVET education included a lack of supportive policies for, and investment in, forest education, and forests and natural resources more broadly. Some respondents commented that the quality of TVET was lagging behind that of university-level forest education.

Survey respondents from the LAC region reported that educational reforms, including the mandatory licensing of technical and public institutes, and the Programme for the

Certification of Labour Competencies, had tended to improve the quality of education. However, they also mentioned that national education policies did not include the forest sector, and that low levels of investment in the forest sector diminished the quality of forest education.

In the NA region, the factors that the most survey respondents indicated could improve the quality of TVET on forestry were support from the government to students and teachers in TVET programmes, forestry-related policies that could improve the awareness of TVET's importance, and increased use of digital tools in teaching and training. The key developments that were seen as reducing the quality of TVET on forestry included a lack of funding, limited employment opportunities, lack of participatory forest management in local communities, and limited attention that TVET forest programmes had been given.

4.4. UNIVERSITY AND COLLEGE EDUCATION

4.4.1. Bachelor's level

4.4.1.1. Education content and competencies

All three respondent groups were asked to evaluate curriculum coverage of 45 forest-related topics and skills grouped under seven themes (Table 7).

TABLE 7.
Coverage of forest-related themes, topics and skills in bachelors' programmes

Themes and specific topics and skills
Forest resources and forest ecology
• Forest biodiversity
• Forest soils
• Forest ecology
• Wood and non-wood forest products
• Forest genetic resources
Forest/tree planning and management
• Forests and climate change
• Forest mapping, inventory, remote sensing and the Geographic Information System (GIS)
• Forest planning
• Silviculture
• Forest landscape restoration
• Range management
• Sustainable harvesting systems
• Agroforestry
• Watershed management

- Wildlife management
- Forest health
- Forest fire management
- Forest conservation
- Urban forestry

Forest services and cultural and social issues:

- Wood as renewable energy
- Forests-based recreation
- Traditional and/or indigenous forest-related knowledge
- Cultural values of forests and trees
- Forests and human health
- Forests, trees and gender issues
- Forests, trees and ethnicity issues

Forestry enterprise:

- Entrepreneurship
- Forest industry, marketing and management
- Wood technology
- Small-scale forest-based enterprise

Forest policy and economics:

- Forest policy and legislation
- Forest tenure and governance
- Forest/natural resource/environmental economics
- Small-scale forestry

Generic skills:

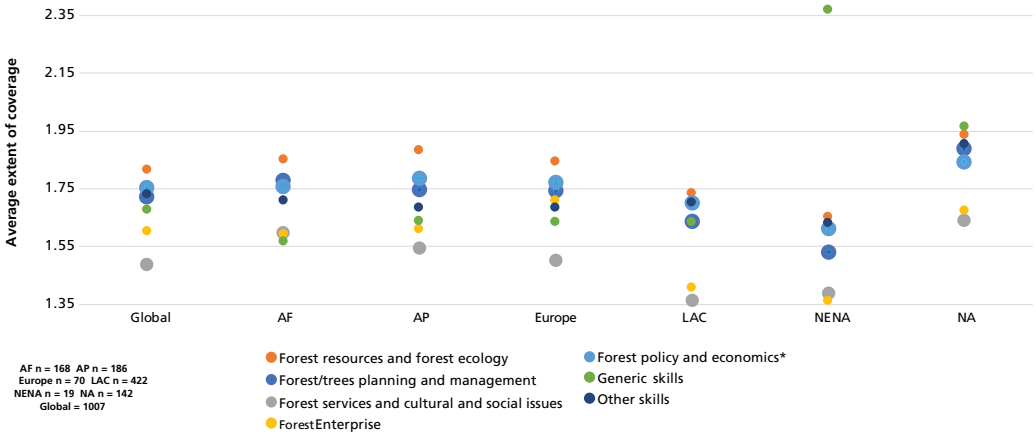
- Science, technology, engineering and mathematics (STEM)
- Critical thinking and analytical skills
- Creative thinking
- Information management skills
- Collaboration and teamwork
- Leadership and management
- Communication (e.g. writing, oral, digital communication)

Other skills:

- Research skills
- Scientific writing
- Practical field skills
- Professional ethics

The semantic differential scale in the questions, and the analysis and interpretations are similar to those described in the sections on primary and secondary education (4.1.1 Education content and competencies in primary education and 4.2.1, respectively).

Figure 16. Coverage of forest-related topics in bachelor's programmes



Note: The theme "accidentally not included" was not included in the Q1 survey.
Scale: 1 = inadequately covered, 2 = sufficiently covered, 3 = excessively covered.

Globally, most of the topics and skills were on average between inadequately and sufficiently covered, although nearing sufficiency level (Figure 16). The highest scores were for forest resources and forest ecology, followed by forest policy and economics; the lowest was for forest services and cultural and social issues. The big picture indicates that better coverage of forest topics at the bachelor's level is needed globally.

However, within each of these 7 themes there was variation among individual topics and skills, in some cases ranging from inadequately to excessively covered. In all regions except NA, one or more topics were rated as insufficiently covered. They included forests, trees and gender issues; traditional and/or indigenous forest-related knowledge; cultural values of forest and trees; and forests and human health.

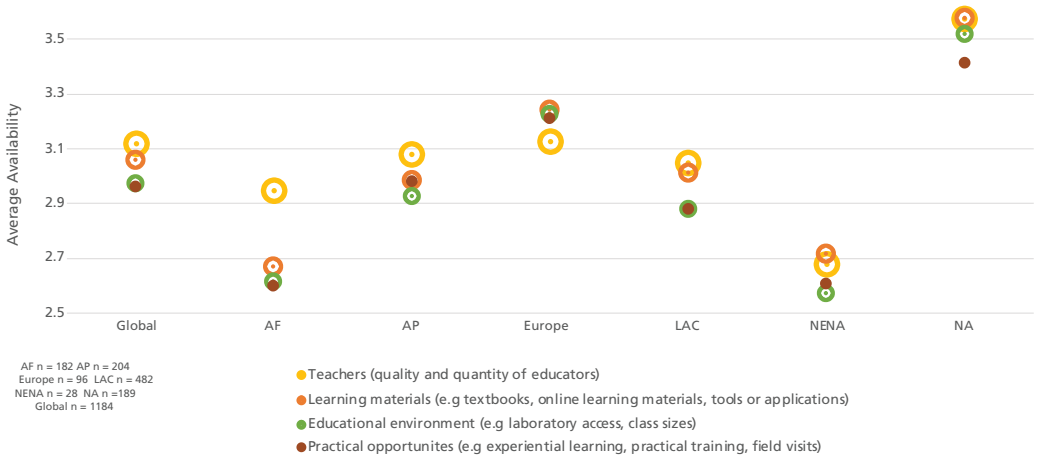
The best overall scores were in the NA region (1.83), followed by the AF, AP and Europe regions, which had similar average scores, and the NENA and LAC regions, which had the lowest average scores (1.60). Some topics were clearly considered sufficiently or almost excessively covered. In the AF region, for instance, these topics were forest biodiversity, forest ecology, wood and non-wood forest products, silviculture, agroforestry, forest policy and legislation, forest/natural resource/environmental economics, forest tenure and governance, and cultural values of forests and trees. In the Europe region, more than 60 percent of all respondents reported that forest biodiversity, forest soils, forest ecology, and wood and non-wood forest products (NWFPs) were sufficiently covered. In the LAC region, most respondents considered inventories, remote sensing, silviculture, and forest planning sufficiently covered. In the NA region, most of the individual topics were considered on average to be nearly sufficiently covered.

4.4.1.2. Educational resources and policy

In all regions, all three respondent groups on average considered resources to be *moderately* available (Figure 17); only some minor differences among regions and respondent

groups were reported. The region that respondents gave the highest rating for resource availability was NA, followed by Europe. The lowest rating was given for the AF and NENA regions. Except for in the Europe and NA regions, an educational environment conducive to learning and opportunities for practical training was considered to be limited in all regions, and especially so in AF and NENA. Some respondent groups were systematically more critical of resource limitations than others. For instance, of European respondents, the professional group was the most critical.

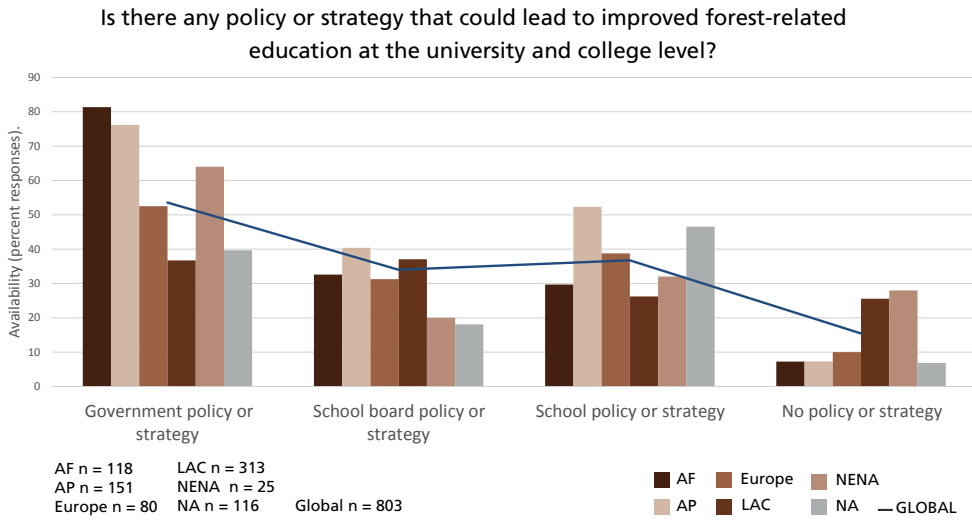
Figure 17. Availability of resources in forest degree programmes at the bachelor's level



Note: Scale: 1= *not at all*, 2= *to a limited extent*, 3= *moderately*, 4 = *very much*.

The availability of supportive policies and strategies for bachelor's level programmes were evaluated by professionals and teachers (Figure 18). In almost all regions, respondents indicated that the most common source of policies and strategies was the government (with school board policy being equally important in the NENA region), followed by school administration policies. However, some differences within regions were apparent, and there was a considerable number of "unable to answer" responses, for instance, in the NA region. A significant number of LAC and NENA respondents indicated that there were no clear policies or strategies.

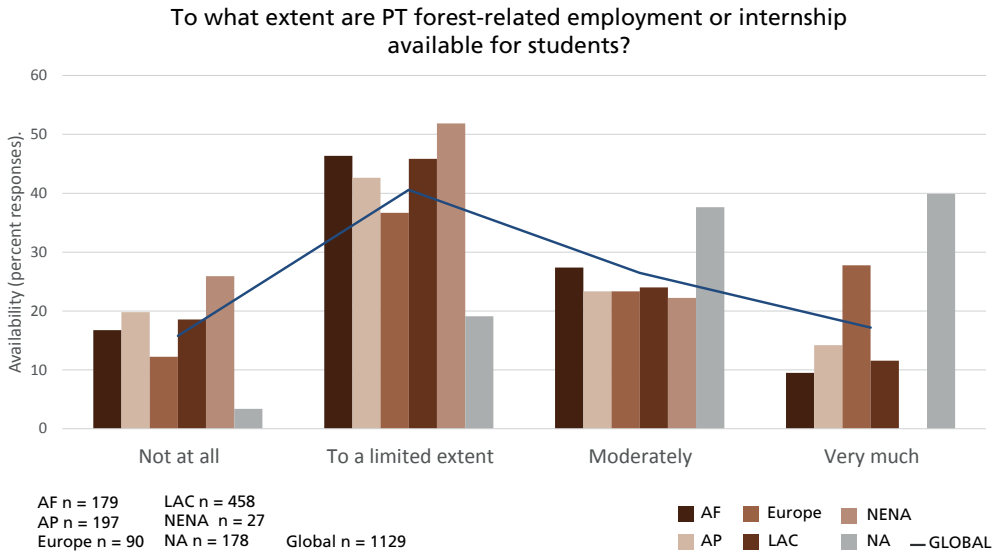
Figure 18. Policies or strategies leading to improved forest-related education in bachelor's programmes



4.4.1.3. Workplace readiness and employability

Respondents from all three respondent groups were invited to give their opinions on the availability and effectiveness of part-time, forest-related employment or internships at the bachelor's level. All groups in all regions agreed that these activities would increase students' learning. The global picture given was that part-time, forest-related employment or internships were not available at all or were available to only a limited extent (Figure 19). The exception was the NA region where teachers and students considered that part-time forest-related employment or internships were available *moderately* to *very much*. Teachers in the Europe region also had this perception.

Figure 19. Availability of part-time employment or forest-related internships at the bachelor's level



All three respondent groups were asked about: students' preparedness to enter the workforce; their job prospects upon graduation; impacts of gender and race/ethnicity on graduates' employability; and availability of affordable professional training after graduation (continuing education) (Table 8).

Respondents on average indicated that they felt students were *moderately* prepared to enter the workforce. It is interesting to note that professional respondents, who, as employers, would be expected to be the best judge of graduates' workplace readiness, consistently ranked students lower in readiness than did teachers, administrators and students. It was believed that, to some extent, impacts of gender and race/ethnicity on employability were limited. In all regions, gender was on average not an issue in employability, with respect to finding a job, or the kind of jobs for which graduates were considered. However, it should be noted that 5–30 percent of respondents, mainly students, *very much* perceived gender to be a factor. Race/ethnicity was perceived as either not a factor or a factor of limited importance in all regions except LAC, where it was considered of limited to moderate importance. Availability of professional training (continuing education) was considered to be moderate in Europe and NA, moderate or available to a limited extent in AP, but available to only a limited extent in LAC and NENA.

TABLE 8.
Workplace readiness and employability at the bachelor's level

Region\ topic	Preparing students to enter the workforce	Job prospects upon graduation	Impacts of gender	Impacts of race and ethnicity	Professional training
AF	+(+)	-	-	-	?
AP	-/+	+	-/+	--	-/+
Europe	+(+)	?	-(-)	?	+
LAC	+	?	+	-/+	-
NA	+(+)	?	-	-	+
NENA	+	+	-/+	--	-

Note: Scale: Average responses: -- *not at all*, - *to a limited extent*, + *moderately*, ++ *very much*, ? results missing in regional reports. -/+ between *not at all* and *to a limited extent*, +(+) between *moderately* and *very much*.

4.4.1.4. Digital readiness

The global survey asked about the use of seven categories of digital tools in teaching. Digital tools in general were valued to a great extent in all regions by all respondent groups. However, perceptions of the current use of these tools varied among regions and respondent groups. The greatest use was reported in the Europe and NA regions, followed by the LAC region. Respondents in the AP region felt that forest education was behind to some extent in use and those in AF and NENA regions reported that use was limited.

The survey indicated that the three main tools used globally were geospatial tools and technology, communication and publication tools, and tools for managing, editing and sharing documents. In most regions, digital tools for field and mill operations were the least used. Interestingly, in all regions, teachers felt that the use of all tools was greater in extent than did students. Tools that teachers and students indicated they would like to see used more varied among regions, but new technological solutions such as enhanced media were high on the lists in all regions, with the exception of AF. Global Forest Information System (GFIS) and the FAO eLearning Academy and Forest Learning were reported as the most well-known tools among bachelor's students.

4.4.1.5. General developments and trends in university and college-level forest education

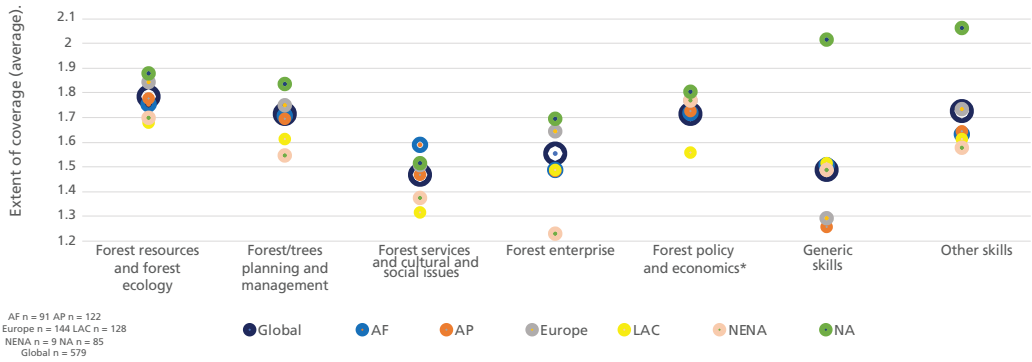
Survey responses to questions about enrolment trends over the past decade in bachelor's education were mixed within and across regions and respondent groups. The fact that professionals were asked to consider university education as a whole, whereas teachers were asked to focus on their own programme might explain some of the variability in responses. Teachers frequently reported that student enrolment was either decreasing or increasing, whereas the most frequent response among professionals was that it was stable.

4.4.2. The master's and PhD level

4.4.2.1. Education content and competencies

The analysis at the master's and PhD level utilized the same scheme and analytics as those used for undergraduate education (see section 4.4.1). Ratings of the adequacy of coverage of forest-related topics and skills varied greatly among regions and respondent groups. On average, across all seven topics, the NA region had the highest scores (i.e. best coverage) and the NENA region had the lowest (Figure 20). The theme that globally was considered the least well covered was forest services (such as recreation and human health) and cultural and social issues, followed by generic skills (Figure 19). The latter topic also exhibited the greatest differences among regions. Globally, forest resources and forest ecology were considered to be the theme best covered in master's and PhD forest programmes, and variance between regions was also small.

Figure 20. Coverage of forest-related topics in master's and PhD programmes



Note: Topic accidentally not included in Q1 survey.
Scale: 1 = *inadequately covered*, 2 = *sufficiently covered*, 3 = *excessively covered*.

Within the theme of forest services and cultural and social issues, the following topics were considered inadequately covered in all regions: forests, trees and gender issues; traditional and/or indigenous forest-related knowledge; cultural values of forest and trees; and forests and human health.

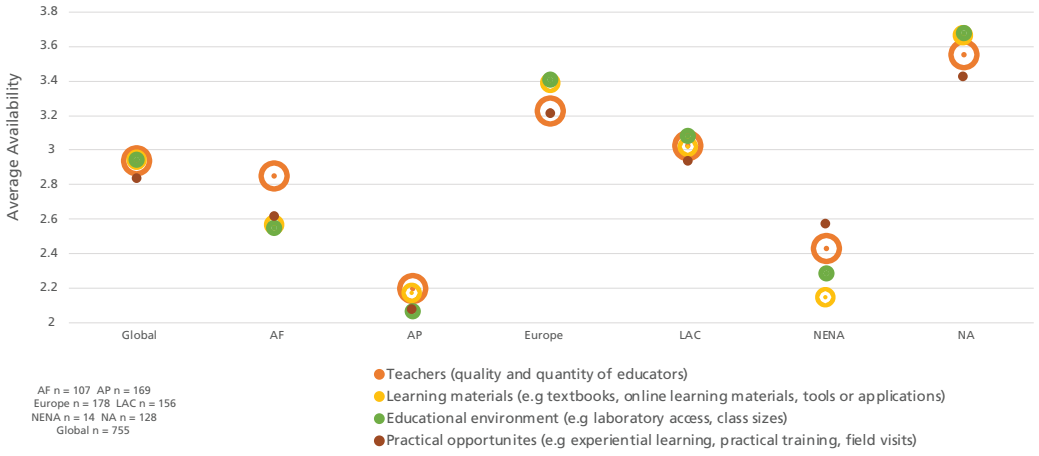
Some findings on adequacy of coverage of specific topics in different regions were as follows. In the AF region, topics that were reported to be sufficiently or excessively covered included wood and non-wood forest products, forest ecology, silviculture, forest planning, and wildlife management. In the AP region, a large share in more than one respondent group felt that forest biodiversity and forest conservation were sufficiently covered. In the Europe region, entrepreneurship and small-scale forest enterprise topics

were seen as very inadequately covered by professionals and by most teachers, whereas students considered them sufficiently covered. In the LAC region, there were discrepancies among professionals, teachers and students; professionals expressed more dissatisfaction with the coverage of topics and skills than the other two respondent groups.

4.4.2.2. Educational resources and policy

Globally, the four categories of educational resources exhibited the same level of availability on average, approaching moderate levels (Figure 21). The availability of resources varied considerably among regions, however. The educational resources were considered most in the NA region followed by the Europe region, both at levels between moderate to *very much* available. The lowest availability of resources was reported in the AP and NENA regions, where availability of resources was considered on average to be closer to limited than to moderate (Figure 21). Resources in AF and LAC regions were considered *moderately* available. In all regions, except NENA, the availability of practical learning opportunities was considered to be lower than most other resources. The availability of a conducive educational environment was considered to be particularly low in the AF, AP and NENA regions. Some differences among respondent groups were also detected. For example, in the AP and Europe regions, students were the least critical of the availability of resources in degree programmes whereas professionals were the most critical.

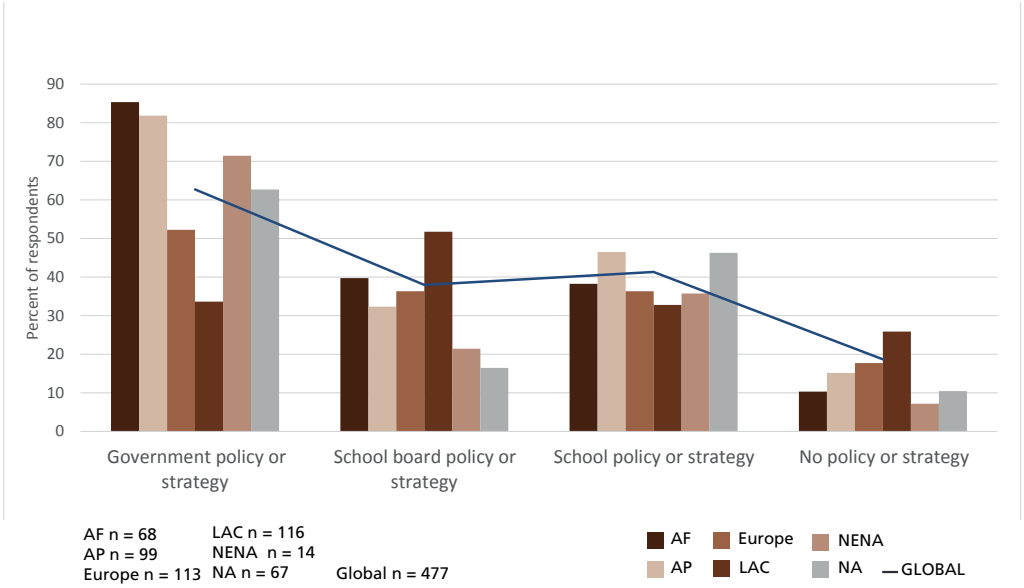
Figure 21. Availability of resources in forest degree programmes at the master's and PhD level



Note: Scale: 1= *not at all*, 2= *to a limited extent*, 3= *moderately*, 4 = *very much*

Supportive policies and strategies leading to improved forest education were evaluated by professionals and teachers. In general, respondents believed that the most common policies were found at the government level, followed by schools (Figure 22).

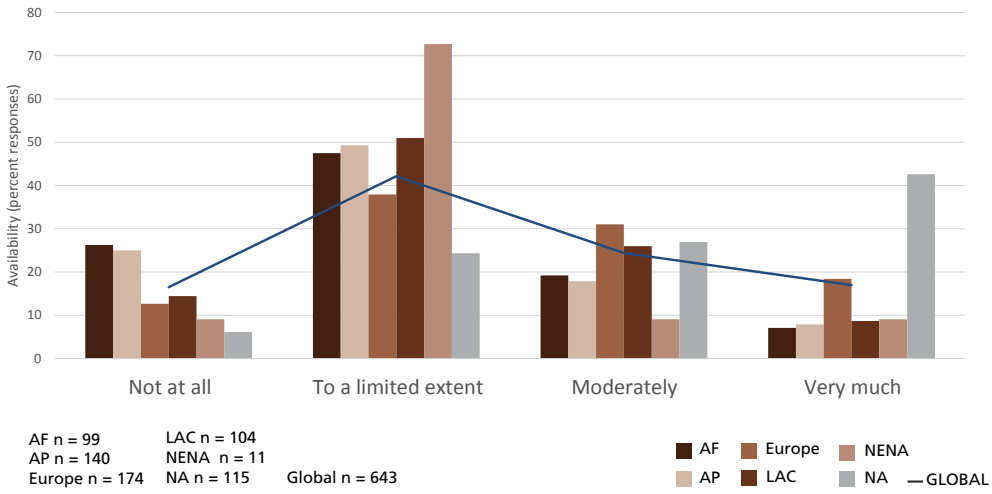
Figure 22. Policies or strategies leading to improved forest-related education at the master's and PhD level



4.4.2.3. Workplace readiness and employability

All respondent groups evaluated the availability and effectiveness of part-time forest-related employment or internships for master's and PhD students (Figure 23). All respondent groups in all regions agreed that these activities would increase student's learning. Most respondents reported that part-time, forest-related employment or internships were not available at all or were available to only a limited extent. However, as was reported at bachelor's level, the NA region was exceptional in that all respondent groups considered part-time forest-related employment or internships to be available at moderate to very high levels. Most Europe region teachers also shared this consideration.

Figure 23. Availability of part-time employment or forest-related internships at the master's and PhD level



All the respondent groups were asked about students' preparedness to enter the workforce; their job prospects upon graduation; impacts of gender, race/ethnicity as an issue in employability; and the availability of affordable professional training post-graduation (Table 9).

Survey findings showed that, among all respondent groups, on average, education is *moderately* preparing master's and PhD students to enter the workforce. It is interesting to note that professional respondents consistently indicated a lower level of workplace readiness than did teachers and administrators and students.

As with the bachelor's level, survey results indicate more mixed results for the other four major indices of workforce readiness and employability of graduate students. In all regions except LAC, gender was reported *on average* not to be an issue in employability, whether it was about finding a job or the kind of jobs for which graduates were considered. However, 5–30 percent of respondents, mainly students, perceived gender to be *very much* a factor. When the results were analysed by gender, as in the AP report, they showed that women more often than men say that gender was *moderately* or *very much* a factor both in a graduate's ability to find a job and the kinds of jobs for which they were considered. These findings were similar to those reported for the bachelor's level.

Similarly, race/ethnicity was reported *on average* not to be an issue in employability. However, in some regions, a considerable proportion of students reported that race/ethnicity was *moderately* or *very much* a factor in a graduates' ability to find a forest-related job upon graduation, with values at around 40 percent in the LAC and NA

regions, and 15 percent in the AP region. However, the number of respondents was very limited or missing for some regions.

Professional training opportunities for graduate students were viewed as moderate in the Europe and NA regions, as was the case at the bachelor's level. These regions are followed by the AP region, with limited to moderate opportunities, and the AF, LAC and NENA regions, which reported having limited opportunities.

TABLE 9.
Workplace readiness and employability at the master's and PhD level

Region\ Topic	Preparing students to enter the workforce	Job prospects upon graduation	Impacts of gender	Impacts of race and ethnicity	Professional training
AF	+	?	-	-(-)	-
AP	+	+(+)	-	-	-/+
Europe	+	?	-	?	+
LAC	+	?	+(+)	-(-)	-
NA	+	?	-	-	+
NENA	+	-	-	?	-

Note: *Scale: Average responses across all respondent groups: -- *not at all*, - *to a limited extent*, + *moderately*, ++ *very much*, ? results missing in regional reports, -/+ between *not at all* and *to a limited extent*, +(+) between *moderately* and *very much*.

4.4.2.4. Digital readiness

In all regions and in all respondent groups, digital tools were considered *moderately* or *very valuable* in learning at the graduate level. Their actual use was considered moderate in all regions except in the AF and AP regions, where they were used to only a limited extent.

The survey showed that the types of digital tools used is similar globally. The three tools most frequently used were communication and publication tools, geospatial tools and technology, and net-based research tools. The most commonly used platforms were the Global Forest Information System (GFIS) and FAO eLearning Academy.

The responses indicated a few regional specificities. In the Europe region, digital tools for field and mill operations were commonly used. In the NA region, PLT was used more than GFIS. In the NENA region, respondent groups interpreted 'digital tools' in different ways, with students focusing only on geospatial tools, professionals putting more weight on other digital tools, and teachers emphasizing virtual conference meetings. The FAO Sustainable Forest Management Toolbox was one of the most frequently used tools in the NENA region.

4.4.2.5. General developments and trends in university- and college-level forest education

Similar to the survey results for bachelor-level forest education, perceptions of enrolment trends over the past decade at the master's and PhD level vary substantially, both within and among regions. As indicated earlier, professionals were asked to consider university education as a whole, whereas teachers were asked to focus on their own programme. The perceptions of professional and teacher respondents align in the AF and AP regions. For instance, in the AP region, decreasing and increasing responses were between 30 and 35 percent in both respondent groups. The situation is completely different in the NA region, where perceptions of professional and teacher respondents were highly different; the most common responses were stable and increasing among professionals, whereas teachers said that the trend was either decreasing or stable.

4.4.3. All university and college levels

The professional respondent group was given the opportunity to comment on all levels of university and college education collectively. However, only 185 respondents globally to this set of questions, and two regional assessment reports did not include information from responses received. Thus, the results for all levels of education in universities and colleges collectively are not reported here. Readers can refer to the regional assessment reports to find data collected at the regional level.

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5. Discussion and conclusions

This section discusses key findings of the regional consultations and the regional assessment reports. Before discussing the findings at the various educational levels covered by the assessment, some general comments about them are provided below.

It is unquestionable that the COVID-19 pandemic negatively affected the number of survey responses received. Indeed, the project team received numerous communications that indicated that administrators, teachers and students were so consumed by dealing with the pandemic that they did not have time to take or complete our survey. The fact that 2 741 people completed the survey questionnaire in this challenging time is testament to the importance that they attach to forest education and to understanding the status and needs facing it today. The survey was the most comprehensive survey of formal education ever carried out on a global level.

In order to keep the scope of the assessment manageable, the decision was made to limit it to formal education from primary through tertiary levels. Pre-primary (i.e. kindergarten) and post-tertiary (i.e. continuing/workplace) education were not covered, even though the project partners fully appreciated the importance of these elements to the forest-related education process. They are part of the 'pipeline' that feeds the professional workforce. Each component has both unique and reinforcing roles—the end goal being to maximize the quality and diversity of people in the workforce in numbers that meet the need. As with all systems, there is feedback that either reinforces these objectives or diminish them. A good case in point is the diversity of the workforce. How people in the workforce are treated and how they interact with the general public have an impact on whether or not young people will decide to enrol in forest-related certificate and degree programmes at the post-secondary (i.e. TVET and UC) level. And once they are enrolled, how they are treated influences their decision to stay and pursue a forest-related career. Thus, issues of equity and inclusion are fundamental to obtaining and maintaining a high-quality, diverse workforce. As comprehensive as this model may seem, there is also the need to educate the general public about the importance of forests and their contributions to the SDGs.

The project partners recognize the challenge of finding the balance in the post-secondary curriculum between the more traditional aspects of forest education and emerging elements, including: discipline-specific vs. non-discipline-specific (i.e. "generic") knowledge and skills; disciplinary vs. multidisciplinary, interdisciplinary and transdisciplinary approaches; basic vs. applied science; the provision vs. regulation of cultural and supporting services of forests; ecological/environmental aspects of sustainable forest management vs. economic and social dimensions; traditional issues in forest management (e.g. growth and yield, wildfire management, and harvesting systems)

vs. emerging issues (e.g. climate change, human health, urbanization, and Indigenous Peoples' perspectives); local vs. regional and global issues; teaching- vs. learning-centred methods; classroom vs. field/lab/hands-on learning; individual vs. group/peer learning; formal vs. informal learning; educational institution learning vs. workplace learning; and Western science approaches to learning vs. traditional/indigenous approaches. A key finding of the assessment is that needs and approaches to forest education vary considerably among and within regions, even within countries. Educational programmes must be tailored to fit national and local circumstances.

The assessment revealed awareness of some overarching actions that would benefit forest education, including ameliorating a negative public image of professional forest-related jobs and careers; developing better collaboration between educational institutions, the forest sector (private and public) and the general public; improving demographic diversity in the post-secondary student population; and strengthening digital readiness at all levels of education.

The data collected by global survey on forest education supplemented by the six regional consultations represent a wealth of current information on the status and needs in forest education. However, it was not possible to include and analyse all of these data in this global assessment. Readers are encouraged to refer to the regional assessment reports and are invited to use assessment data in their own research.

5.1 REGIONAL CONSULTATIONS

Regional online consultations with key informants were carried out in all six regions. Around 500 participants provided comments on regional report drafts, discussed the results of the survey, and provided additional insights. Regional reports on consultations are available at FAO's website[6] and have been incorporated into the six regional assessment reports that form the basis for this global assessment report.

Consultations generally validated the survey results at all levels of education from primary to universities and colleges. The survey asked about the situation before the COVID-19 pandemic, and the consultations provided valuable information on the associated challenges faced and ways in which the pandemic had led to increased use of digital tools and online learning.

Some highlights from the consultations are provided below.

Primary and secondary levels

Consultation participants in several regions proposed concrete actions to be carried out in order to develop the desired quality of teaching and learning at the primary and secondary levels, as follows:

- Forest education should start prior to primary education.
- Forest-related topics should be included in the national curricula for primary and secondary education, both as separate individual subjects and integrated with other subjects.

[6] Regional consultations for strengthening global forest education. www.fao.org/forestry/forest-education/98164/en

- Teachers should receive further training in forest-related topics and in pedagogical skills.
- Systematic support should be provided for outdoor learning and using forests as learning environments.

Expanding outdoor learning, including opportunities for students to visit forests and for teachers to use forests as learning environments, was requested by both survey respondents and regional consultation participants.

Technical and vocational education and training

The following describes the main conclusions of the regional consultations on forest education at the TVET level:

- The poor reputation and image of forestry and forest-related jobs and professions negatively affects enrolment levels in TVET forest programmes.
- Financial and economic challenges faced by TVET forest programmes make it difficult to maintain the quality of education.

Universities and colleges

Participants in the regional consultations highlighted that university graduates had inadequate experience in forests. The importance of having a good balance of practice and theory in forest education was stressed, as was the need for students to have systematic opportunities for practicums both in their country of residence and abroad. One solution was to have university-owned forests with field stations. These facilities in some places are providing a teaching and learning environment for primary and secondary education, and also generating income for universities.

5.2. PRIMARY AND SECONDARY EDUCATION LEVEL

Although there are differences between primary and secondary levels and among regions, some common, global-level key findings on forest education at the primary and secondary school level emerged from the assessment. Survey results and the ensuing discussion are largely based on feedback from professionals because responses from teachers and administrators at both levels were limited.

Most primary and secondary education respondents felt that, forest-related topics were not included in the curriculum as *individual* subjects and were included in *other* subjects to only a limited extent. Both professionals and secondary education teachers reported that forest-related topics should be taught more as both individual subjects and in conjunction with other subjects. This perspective is in line with widely used concepts such as Environment and Sustainability Education, Education for Sustainable Development, Learning Outside the Classroom and PLT. They foster a sense of connectedness to the environment typically through experiential learning (UNESCO, 2016; Talero, 2004; Vilhar and Rantasa, 2017; Waite, 2017).

Almost all forest-related topics were considered inadequately covered at both the primary and secondary levels, the most critical ones being the cultural and social value

of forests and trees, traditional knowledge and rights of forest communities, and the contribution of forests and trees to local people. The topics considered to be best covered globally were plants and animals that live in or around forests (biodiversity), respect for forests and nature, and (at the secondary level only) deforestation and forest degradation (Turtle *et al.*, 2015). It may be concluded that these topics and skills are considered the most essential to be learned at the primary and secondary levels. It is also possible that teachers have the greatest familiarity with and thus feel most comfortable in addressing these topics. Even though the importance of secondary education in stimulating youth's interest in continuing their learning about forest-related topics is recognized, it seems this is not being achieved.

In general, most professional and teacher respondents considered access to teaching resources, learning materials and practical opportunities to be limited. This is consistent with findings of many previous studies (e.g. Mtsi and Maphosa, 2016).

The most common teaching approach across regions is lectures. Outdoor learning is almost non-existent in most regions (Kanowski, Dollie and Wyatt, 2020). Survey respondents called for greater opportunities to be given to students for learning in an outdoor environment (Derman and Gurbuz, 2018; Kangas, Vuojärvi and Siklander, 2018). Several systems and organizations around the world already support outdoor learning: see concepts Education for Sustainable Development, Learning Outside the Classroom and PLT above, and also Pagé and DeRocco, 2020; Gabay and Rekola, 2019). Survey respondents also expressed a need for teacher training in the use of digital tools. These results are similar to those found in previous studies (Gill, Dalgarno and Carlson, 2015; Gudmundsdottir and Hatlevik, 2018; Napal Fraile, Peñalva-Vélez and Mendióroz Lacambra, 2018).

A conducive educational environment, such as laboratory access and class size, is a critical resource. Variation in resources among regions is evident, with most resources available in the Europe and NA regions. In most regions, respondents noted that government policies or strategies are available for improvement of forest-related education.

Respondents felt that learning outcomes for forest-related education at the primary and secondary levels were not well developed. Efforts to date seem to focus on appropriate topics and skills. The assessment indicates that teachers will need access to improved learning materials and support, and training for outdoor learning and in the use modern digital tools in forest-related education.

5.3. THE TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING LEVEL

Survey respondents felt that several topics (and in AF and AP, all topics) were insufficiently covered in TVET globally. Particularly lacking were socio-economic subjects: forest, trees and race/ethnicity issues; forests, trees and gender issues; cultural values of forests and trees; and traditional and/or indigenous forest-related knowledge. Professionals considered that these and several other topics and skills (competences) were insufficiently covered in the curricula, whereas teachers considered them insufficiently to sufficiently covered, and students, sufficiently covered. Encinas (2007) reported similar findings.

In addition to this overall picture, several topics might be even less sufficiently covered in particular regions and countries. For instance, in the NA region, some land use and management-related topics such as agroforestry and urban forestry are even less sufficiently covered than socio-economic topics.

Survey respondents felt that the topics best covered related to silviculture and forest management and planning. Similar observations were reported in the literature on tertiary education (Bullard, 2015; Ketlhoilwe and Jeremiah, 2010).

Topics closely related to socio-economic issues such as urban forestry, agroforestry, and forests and human health were also considered insufficiently covered in several regions. Research has indicated that the demand for urban forestry practitioners continues to grow as the urban environment expands over time (Ricard and McDonough, 2007; Driscoll *et al.*, 2015)

Digital readiness was considered critical at all levels of education, but in particular at the TVET level. The importance of integrating digital tools into education has been stressed by others (Sharik *et al.*, 2020, Chuchu and Ndoro, 2019, and Ferreira and Mustaro, 2014). The availability and use of digital tools, and the digital readiness of students were deemed *moderately* available in the Europe and NA regions, but limited in other regions.

Availability of educational resources varied among regions, being perceived as limited or insufficient in the AF, AP, NENA and LAC regions, and *moderately* available in Europe and NA. In most regions, some governmental policies or strategies were seen as having the potential to improve TVET on forestry.

In all regions except LAC, all respondent groups indicated moderate or greater preparedness of TVET students to enter the workforce, but professionals were the most critical. This result seems to contradict the finding that many topics were considered inadequately covered in several regions. This inconsistency may be due to differences in measurement, where topic coverage is atomistic while preparedness is a holistic education by respondents.

Employment availability was limited in most regions. Female students more than male students indicated that gender was a critical issue with respect to employability.

In the NA region, there was a strong belief that enrolments were stable or declining. In all other regions respondents were not unanimous in their perceptions of enrolment trends. This might reflect differences in enrolment trends among and within countries.

Circumstances related to TVET in general vary across regions and within regions. In general, however, TVET seems to lack proper recognition, especially, with respect to university-level education. Moreover, TVET graduates seem to suffer from undeveloped labour markets and working life conditions, issues related to the poor image of forestry jobs in many regions.

5.4. UNIVERSITY AND COLLEGE LEVEL

Educational gaps in UC-level forest education have been pointed out by several earlier studies (e.g. Temu, Okali and Bishaw, 2006). Recognition of the need to include more

social issues in forestry curriculum is not new (Barrett, 1953; Sample *et al.*, 2015; Sharik *et al.*, 2015; Innes and Ward, 2007; Kanowski, 2001; IISD, 2003; FAO, 2003; Brack, 2019; Li and Yuan, 2017). Other topics found to be insufficient in this and earlier studies were traditional and/or indigenous forest-related knowledge and cultural values of forests and trees (Brosius, 1997; Tanyanyiwa and Chikwanha, 2011; Parrotta and Agnoletti, 2007). This global assessment found that even though many of these social topics are today covered better than before, insufficiencies still remain. Concrete actions are thus still needed.

Generic competences have been recognized as insufficient for some time (Sample *et al.* 2015; Rekola *et al.*, 2017; Rekola *et al.*, 2018; Villarraga-Florez, Rodríguez-Pineros and Martínez-Cortés, 2016; Lee *et al.*, 2011). The results of this study suggest that some improvement has occurred in this area; however, generic competences are still at insufficient levels.

Part-time forest-related employment or internships are considered very important learning opportunities, but they are either not available at all or are available to only a limited extent on a global scale. This is one of the most important findings of this study. Despite these deficiencies, most respondents consider that bachelor's programmes prepare students *moderately* well to enter the workforce.

Both our survey results and the literature indicate that forest education faces challenges with respect to gender and minority equality. These groups are under-represented both in the current workforce and among students (Follo, 2002; Arevalo *et al.*, 2012; Gharis; Sharik *et al.*, 2015 and 2019; Bal and Sharik, 2019). Moreover, recent surveys indicate that women and minorities are more hesitant to enrol in UC forest-related degree programmes than are their male and majority counterparts (Bal *et al.*, 2020). The survey showed that on average globally, gender influences employment opportunities more than does ethnicity.

Survey respondents seem not to have unique observations about supportive policies and strategies on bachelor's level forest education; most of the respondents indicated that the most common policy or strategy was likely to originate with the government, followed by educational institutions.

Perceptions of enrolment trends in bachelor's education varied by respondent group and academic programme. Professionals were asked in the survey to provide their enrolment estimate of all national programmes, whereas teachers provided estimates of their own programme only. To estimate enrolment for all programmes at a national level is a much more demanding task than estimating enrolment of the programme in which one works. However, the most interesting question for further investigation is how and why trends differ among programmes. Why are some programmes flourishing and others not? There could be regional and local differences in conditions, such as demand for professionals. There could also be variations among the programmes. It would be useful in future analyses to investigate whether programme content, resources and teaching approaches are correlated with enrolment trends in programmes. It would also be useful to compare perceptions of enrolment trends with actual enrolment numbers. For example, in North

America, it has been observed that enrolments in forestry programmes are increasing only slightly, whereas in several related areas of study, especially those that are broader in scope and are more interdisciplinary, are increasing substantially (Sharik *et al.*, 2015).

Education content and competencies for the master's and PhD level are similar to those for the bachelor's level. Coverage of individual forest-related topics and skills varies greatly among regions and respondent groups. For a given thematic level across all respondent groups, the overall picture is that forest resources and forest ecology, forest/tree planning and management, and forest policy and economics are sufficiently covered, whereas cultural and social issues are inadequately covered. This result is in line with earlier studies on forest undergraduate education (Bullard, 2015; Sample *et al.*, 2015)

Resources for education were considered *very much or moderately* available in the NA and Europe regions, *moderately* available in AF and LAC, and relatively limited in AF and NENA. This is not surprising in light of earlier studies (Gabay and Rekola, 2019). Resources need to be taken seriously, especially because students need practical skills using new technology that calls for new resources (Jegatheswaran *et al.*, 2018). One of the major challenges with teaching and learning resources in all regions is limited practical opportunities such as experiential learning, practical training, field visits and part-time forest-related employment or internships. The relatively good economic climate in North America in recent decades may explain why this region is an exception here.

A key finding of the assessment is that, in all regions, master's and PhD students are considered *moderately* prepared to enter the workforce. Although this picture is better than some studies have shown in the past (e.g. Schmidt *et al.,* 2014), improvements are clearly needed to ensure that graduates are ready for the workplace. Filling gaps in the curricula (e.g. in social and cultural issues in forest management), providing more practical training and opportunities for internships and work, and improving digital readiness are some of the actions that could be taken to prepare students for jobs after graduation. More widespread use of digital tools that are crucial in today's working life, but were found not to be commonly used in all regions. Some of the most advanced tools such as virtual reality and augmented reality are still waiting to be utilized in some regions.

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6. Recommendations

The regional assessment reports on forest education prepared as part of this project included hundreds of recommendations to strengthen forest education at three levels. The aim of this global assessment is to synthesize these recommendations and propose new innovative approaches to address gaps. This section of the report provides a limited in number of recommendations at a more general level. The recommendations below are based on regional reports but also reflect insight and judgement by the authors. Region-specific recommendations can be found in the regional reports.

The top-ten subjects to be developed at the primary and secondary, as well as at the TVET' and UC levels of education are treated under three categories, i.e. content and materials, teaching and learning approaches, and social dimensions.

Content and materials

1. Curriculum.

At the primary and secondary level, more forest-related topics should be incorporated into curricula, but not necessarily as independent subjects. Curricula should be adjusted to cover insufficiently covered topics, such as social and cultural aspects of forests. A global-level tool for national curriculum development such as the *Forest Education Global Core Curriculum* (FEGCO) should be given serious consideration as it provides a platform for global discussion and a benchmark for practical development.

2. Learning materials. For all levels, easy-to-access and low to no-cost, non-commercial, forest-related learning materials should be available. In addition, reasonably priced commercial materials should be provided by educational publishers and public organizations. These business opportunities are highlighted in order to incentivize material producers. Scalable delivery systems such as the *forestra* © platform should be developed using principles of open access and co-creation. Moreover, these systems could potentially deliver commercial material at low cost because of scaling effects (see other services such as music delivery service Spotify©).

Teaching and learning approaches

3. Digital learning. At the primary and secondary levels, new technologies could support enhanced learning environments and could also substitute in certain cases for outdoor learning. At the TVET and UC levels, using digital learning tools would improve skills for students and therefore also increase graduates' employability.

4. Outdoor learning. Forests typically provide the most effective learning environment and thus should be made available at all educational levels.

5. Teachers' education. At the primary and secondary levels, training for teachers in forest-related topics and digital teaching skills should be improved. At the TVET and particularly the UC level, efforts should be made to improve the pedagogical skills of teachers. Online peer-to-peer networking applications, similar to LinkedIn, adapted to teachers' professions, could be useful.

6. Youth activities and work experience. Forest-related (out-of-school) internships, part-time and other work-experience, and youth activities (excursions, workshops, outdoor activities) should be further developed so that students benefit and gain immersive and engaging experiences and practical training. These activities would also help attract young people to TVET and UC forest programmes.

Social dimension

7. Stakeholder engagement. Educational institutions should foster discussions and a common understanding of forest educational issues among teachers, professionals and students, and with stakeholders outside the institutions. At the primary and secondary level, increased stakeholder engagement would boost curriculum development and outdoor learning for children. There should be greater stakeholder engagement at the TVET and UC levels to increase the availability of internships and workplace learning opportunities, which will lead to revising the curricula so they better match the needs of the workplace.

8. Research. Evidence-based solutions are needed in education similar to forest management. Research needs include, but are not limited to, curriculum content, employability (especially at the graduate student level), enrolment trends, what constitutes conducive learning environments, educational materials, didactics and pedagogy.

9. Social learning. Innovative learning applications, such as citizen science and open data applications, should be enhanced in order to raise public awareness of sustainable use of forests and forest products. These applications should also provide learning opportunities for those who have no access to formal education, such as most forest-sector (field) workers. They can contribute to all levels of formal education, continuing education and informal learning.

10. Executive education. Forest-related education for political-level decision-makers should include informal, non-degree training and networking, which have been successful in some countries in order to disseminate forest-related knowledge to facilitate networking and societal impact in support of sustainable forest management.

All of the above-mentioned top-ten topical areas are of the highest priority, and all actors should consider how they could address them. In particular, some recommendations should be spearheaded by specific actors, as follows:

National governments should:

1. incorporate forest education at all levels into strategies and plans to implement the SDGs and other relevant goals and feedback, and to engage in the emerging circular bioeconomy in order to facilitate and expedite the achievement of these Goals;

2. formulate policies and programmes to remove barriers and encourage schools to provide learning opportunities in forests for children and youths;
3. incentivize the private sector to offer work placements and internships to students in forest programmes, and collaborate with forest education programmes to identify needed changes to curricula so that students are well prepared for the workplace.

Educational authorities and institutions should:

At the primary and secondary school levels

1. revise curricula to ensure that children and youth have a broad understanding and appreciation of forests and related career opportunities, and gain a cross-disciplinary view of forests' contributions to sound environmental, social and economic needs of the country and local communities;
2. ensure that teaching covers issues of demographic (in particular, gender and race/ethnicity) inclusion in relation to forests;
3. develop and promote school policies and support innovations for promoting outdoor learning in order to increase students' direct exposure to forests and trees through visits, practical work, tree planting, and forest school activities;
4. establish networks for professionals and teachers to improve school- and nature-based forest education;
5. support and incentivize professional training to equip teachers to provide quality forest education;
6. increase teaching that highlights the range of potential forest-related careers far beyond the traditional ones.

At the TVET and college and university levels

1. update curricula to reflect the modern understanding of the values and uses of forests, new technologies used in the forest sector, and the changing demands of the job market;
2. increase the focus on issues that this assessment found to be lacking, such as:
   - social issues (forest livelihoods, forests and gender, race and ethnicity; indigenous knowledge);
   - other region-specific topics and skills;
3. support enrolment of women and racial/ethnic minorities
4. develop internships, out-of-school activities, part-time and other work-experience programmes with employers active in the forest sector, and include in these programmes monitoring systems to ensure that students benefit and gain practical workplace experience;
5. support and incentivize professional training to equip teachers to provide high-quality forest education, including, modern digital technology.

Professional organizations (including private sector organizations and NGOs) working in the forest sector should:

1. support educational institutions and educational authorities in reviewing and revising curricula for forest education at all levels;

2. help educational institutions and educational authorities adapt generic information about forests and forest careers so that it is relevant at the national and sub-national levels;
3. develop and/or engage in initiatives and commercial services to increase exposure of students at all levels of education to forests and potential careers in forest-related careers by providing:
    - small grants, access to forest sites to enable students to conduct research projects there, and ambassadors to speak to students;
    - internships and/or work placements;
    - providing on-the-job training and continuing education programmes.

International donors, organizations and regional cooperating bodies should:

1. continue to expand efforts to raise awareness of decision-makers, the public and international donors on the importance of forest education and on the need to strengthen it in areas and places where improvements are needed;
2. support capacity-building of forest education institutions and programmes by facilitating scholarships, exchanges and other activities that promote learning across institutions and settings;
3. support global initiatives, stakeholder engagement and partnerships in forest education, such as forestra ©, the Forest Education Global Core Curriculum and PLT;
4. support research, networking, and innovation initiatives aimed at strengthening forest education.

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